SCIENCE

ADHESIVES AGE

MANUFACTURE, APPLICATION, TECHNOLOGY, RESEARCH AND MARKETING

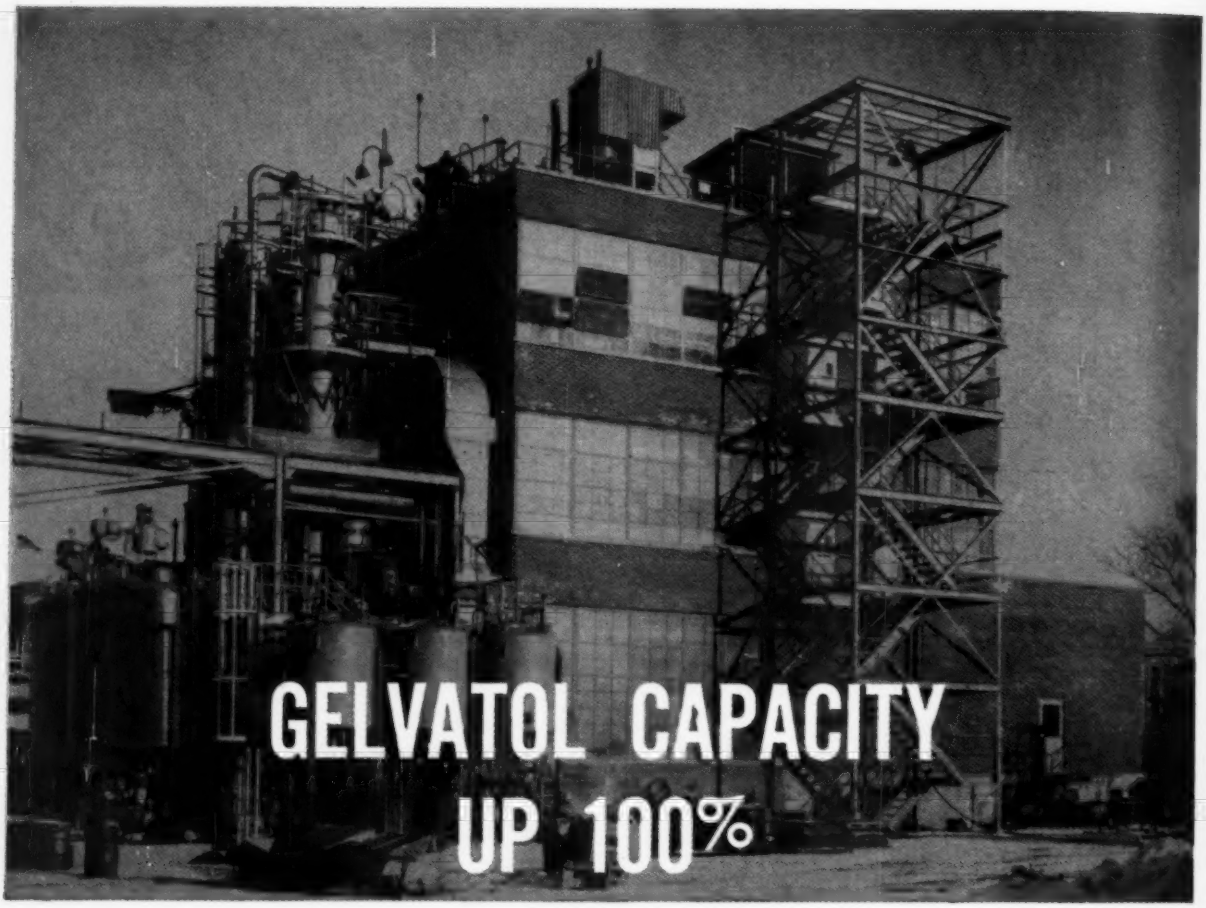
APRIL, 1960

Serial Dept.

APR 12 1960

ADHESIONABLE FLUOROCARBONS THROUGH IONIZING RADIATION

page 26



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3-90	45-55	2-4	99-97.9
20-90	35-45	19.5-24	89-86
1-60	28-32	0-2	100-99
3-60	23-28	2-4	99-97.9
20-60	21-25	19.5-24	89-86
1-30	4-6	0-3	100-98.5
20-30	4-6	19.5-21.5	89-87.7
40-20	2-3	37-42	77-72.9
40-10	1.3-2	37-42	77-72.9

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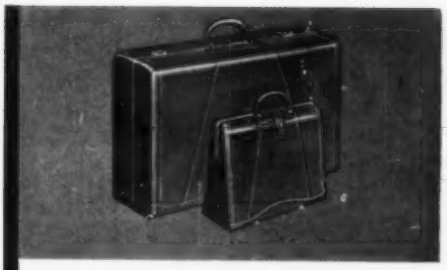

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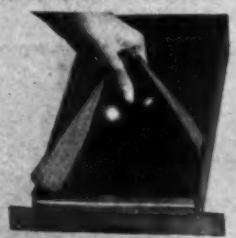

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Engineer Lawrence Friedman of Radiation Applications, Inc., is shown removing a pilot run of plastics from a Cobalt-60 chamber. For details on a radiation grafting technique which makes fluorocarbons bondable, see the article beginning on page 26.

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PALMERTON PUBLISHING CO., INC.

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TYPICAL PRODUCTION METHODS

Most companies develop their own techniques to bond stack laminates most efficiently. The three most commonly used are:

1) Coat, stamp, and stack;
2) Stamp, pre-coat, then stack;
3) Coil or stack, then vacuum impregnate.

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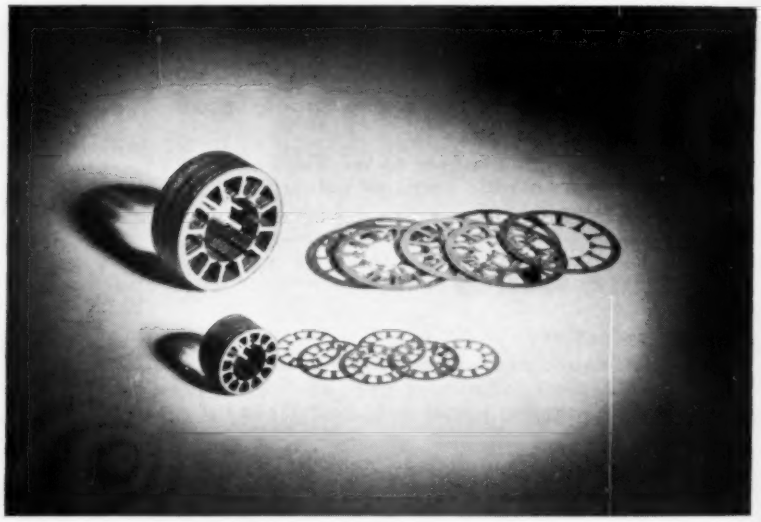

Now you can machine adhesive-bonded stack laminations of magnetic steel cores . . . machine them to tolerances as critical as you can control your equipment . . . *without fear of failures.* In addition, these laminations can now be produced without the internal stresses that have plagued the industry for so many years . . . can be made far more accurately, more uniformly, more swiftly than has ever been possible with riveted assemblies.

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Write for Technical Data Sheets detailing adhesive laydown, curing cycles, bonding methods, etc., of BONDMASTER Series "E" adhesives for the electrical industry.

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EDITORIAL

A Guest Editorial

Proper Usage Factor in Performance

The last few years have seen a great increase in the use of many types of adhesives. In the eyes of most people this means that all that is needed to get any adhesive job done is to pick the proper adhesive, be it one of the new glamorous types, or one of the more staid older varieties.

This only solves half of the problem of properly adhering materials. The other equally important factor is that the adhesive should be used correctly. It is our opinion that as many problems are caused by incorrect usage of the right adhesive as by using the wrong adhesive. There are many reasons why this should be of interest to the adhesive user. The correct usage of an adhesive will allow the use of a minimum amount of adhesive to get a satisfactory bond. The number of defective parts are reduced and the time of the people involved is used to the best advantage.

With the use of more adhesives for structural purposes it becomes of greater importance to use adhesives correctly since many of these are used on specification items. It is rather easy to see that the specification will not be met unless the materials are bonded correctly. This includes proper preparation of the surfaces and the proper application and curing of the adhesives. We cannot stress too greatly the need for using adhesives in the proper manner and almost all manufacturers will try to be helpful in working out these problems.

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CONSULTANT'S CORNER

By Dr. Irving Skeist

Vinyl to Pavement

Question: An airport supply company, we are seeking an adhesive which can be used to bond polyvinyl chloride strips to mosaic paving stones to indicate pedestrian crossings. The adhesive must dry quickly and prevent any sliding of the strips despite rapid braking by vehicles and common carriers.

Answer: Polyvinyl chloride strips are superseding painted strips as traffic markers in many busy locations. They cost more initially, but are applied with briefer interruption of traffic, and last several times as long—*provided* the adhesive bond is a good one.

Proper formulation begins with the vinyl strip itself. This should be quite rigid. To the extent that plasticizers are required, they should be of the polymeric type rather than dioctyl phthalate and other conventional low molecular weight plasticizers, since these latter are likely to impair the bond

Vinyl can be bonded to a variety of surfaces with a contact cement made from nitrile rubber, alone or blended with vinyl chloride polymer. Ketones are employed as solvents. A "wash coat" is sufficient—a light application drying to a film of several microns thickness. When the solvent has evaporated, the strip can be rolled without fear of mass transfer of the coating.

At the pedestrian crossing, the pavement must be cleaned of dust, loose gravel, grease, etc. The strip is unrolled with the coated side upon the road, and air is pressed out with a rubber roll.

An American company has developed an alternate technique without adhesives. The polyvinyl chloride strip is extruded on the spot and pressed to the road while hot.

Q-140

Readers who would like to contribute their own experience with problems similar to those discussed in Dr. Skeist's column are invited to write to ADHESIVES AGE, *101 West 31st Street, New York 1, New York. Please refer to the code number given at the end of each question and answer group.*

CONSULTANT'S CORNER

Cements for Upholstery

Question: Like other manufacturers of upholstered furniture we have trouble gluing a double welt gimp to our finished product. At present we are using an adhesive which is a latex-base cement that is water soluble when wet and relatively waterproof when dry. Our problem is, however, that we are forced to pin the gimp in place with tacks while the glue is setting. The tacks are removed once the glue has dried thoroughly.

We have tried several latex cements that are faster drying than the water soluble cement we are now using, but found that these cements, which used naphtha as a solvent, tended to crawl and brown with age, leaving very undesirable marks on the finished furniture.

Is there any type of cement you can recommend which we can apply with a squeeze bottle or other portable applicator, and which is rapid setting enough to permit the elimination of pinning without the danger of soiling the fabric.

Answer: A vinyl acetate copolymer emulsion should be adequate. It can be applied from a squeeze bottle. For quick grab, it can be made more tacky by incorporating a few per cent of trichlorethylene or perchlorethylene. The brown staining which you observed may be due to an antioxidant or other ingredient in the latex, rather than the naphtha.

Q-151

Metal to Metal

Question: We would like information about an adhesive for use in bonding a metal frame to office files or other equipment made of metal or hard surfaces in general. The metal frame is used for holding labels inserted through a slit on one side of the frame.

Answer: A neoprene-phenolic contact cement should be suitable here. Both surfaces are coated and the solvent is allowed to evaporate before pressing them together.

Epoxy (epoxide) adhesives can also be formulated for this application. They have the advantage of being 100 per cent reactive, with no solvents to evaporate. On the other hand, they are not as tacky as the neoprene; consequently the bonding and curing is accomplished most easily with the glue line in a horizontal rather than vertical position.

The metal should be cleaned as though it were being prepared for electroplating.

Q-141

Dr. Skeist is associated with Skeist & Schwarz Laboratories, Inc., 101 West 31st Street, New York, N.Y. He is the author of the recently published book, "Epoxy Resins."

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Unsupported Tape

Adaptable to both sandwich structures and metal-to-metal bonds, Metlbond 406 is an unsupported, calendered tape 18 inches wide. The material can be easily trimmed to the shape of the area to be bonded. At room temperature the adhesive is dry, pliable and easy to handle. At elevated temperatures, however, it

softens and flows, wetting the bonding surfaces. With the continued application of heat and moderate pressure, the adhesive cures into a tough, high-strength film capable of maintaining excellent bond strengths at temperatures up to 200°F. Since it cures without releasing any solvents or condensation products, there is no need to provide for the escape of volatiles from the bonding area. *Narmco Resins & Coatings Co.*

P-280

Pigment Binder

Several desirable properties for application printing on cotton, glass and synthetic fibers are featured in Morpatex 50, a metallic pigment binder. The product is supplied as a water extendable emulsion, utilizing thermoplastic and elastomeric polymers specially compounded to meet the needs of the textile printing industry. It offers prolonged resistance to dry cleaning and laundering, a soft hand, good luster unaffected by pigments or organic colors, non-discoloration on aging, non-tarnishing of metallic powders by perspiration, and complete stability after incorporation of the metallic powder. It is said to be an effective binder for gold, copper or aluminum powders and can be printed along with other colorants in practically the full range of dyestuffs. *Morningstar-Paisley, Inc.*

P-281

Caulking Compound

Thorospan is a new sealant and caulking compound for glass, metals, concrete, masonry, porcelain, rubber and wood. The product is a synthetic rubber base compound. It is sold in two grades: Pourable for self-leveling, fast application on horizontal work, and No-Flow, a heavier consistency, for vertical or overhead applications. It will bond to practically every building material, states the manufacturer. Thorospan is said to be especially well adapted to curtain wall construction and can be applied by hand, power caulking guns, putty knives or trowels. It is non-sagging and gives permanent resilience over a wide temperature range without becoming tacky in hot weather. *Standard Dry Wall Products, Inc.*

P-282

Glueable Release Paper

To permit its use in applications requiring both release and adhesion, Patapar Releasing Parchment is release treated on one side and glueable on the other. The fiber-free treated side releases readily from sticky or tacky substances; the opposite side accepts glue, cements and other adhesives. Suggested applications include use as a releasing liner on cores of cellophane and other pressure-sensitive tapes, packaging of various types of sticky food products, and inner liners of bags for packaging synthetic rubber and other tacky materials. *Paterson Parchment Paper Co.* **P-283**

Two-Component Adhesive

Statbond EP-110 contains a safety hardener system. One component of the adhesive is a blue-colored paste; the second, a yellow-tinted hardener. In use, equal lengths from a tube of each component are squeezed onto a clean dry surface, such as a glass plate, and mixed until a light green color results. The adhesive will cure at room temperatures or can be oven heated for rapid setting. It can be used for metals, glass, wood, thermosetting plastics, hard or vulcanized rubber, etc. *American Latex Products Corp.* **P-284**

Unvulcanized Rubber Bondant

Adhesive EX-B501-4 is a single-coat adhesive for bonding unvulcanized neoprene and nitrile stocks to metals and other substrates. It is said to provide excellent resistance to severe environments and eliminate underbond corrosion. Suggested applications include use as an environmentally resistant primer with many other adhesives. It may be applied to clean surfaces by spraying, dipping and brushing, and dries quickly to give a hard coating which gives good resistance to handling during processing and storage. It may be bonded immediately or coated parts can be held for 30 days at room temperature without sacrificing bondability. *Hughson Chemical Co.*

P-285

Tub Sealer

Developed to provide a lasting seal between tubs and walls, Kwik-Seal is water soluble at the time of application and sets to a firm rubbery consistency that is permanently

waterproof. It does not slump and will not pull away from adhering surfaces, states the manufacturer. It can be used for sealing around bathtubs, lavatories, sinks, and to repair grouting around plastic or metal tile. *Dicks-Armstrong-Pontius, Inc.*

P-286

Epoxy Novolac Resin

Systems that function well at temperatures above 400°F. are formulated with D.E.N. 438 and common epoxy curing agents. The range of applications include adhesives, structural laminates, prepreg laminates, filament-wound structures, printed circuit board and electrical insulation. The resin's functionality averages 3.3 epoxy groups per molecule. The close-knit crosslinking of the cured epoxy novolac is said to assure better retention of mechanical properties at high temperatures. No residual phenolic hydroxyls are present to limit shelf stability. *Dow Chemical Co.* **P-287**

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Pipe Protection Tape

Conformability over a broad temperature range and optimum properties for pipe corrosion protection are said to be some of the features of Scotchrap No. 40, a polyvinyl chloride pressure-sensitive tape. No heat or tools are required in application. Its balanced high-tack adhesive system stops tape displacement caused by movement of the soil or pipe, states the manufacturer. The tape resists the action of acids, alkalies, salts, petroleum oils and refined petroleum products. In addition, it is not affected by fungi or mold, and its high insulation resistance and electric strength remain stable in the presence of water. *Minnesota Mining & Mfg. Co.* **P-289**

Epoxy Fixture Mount

Fixtures and other items can be mounted on wall and ceiling with Permacel PA 1042 Fixture Mount, a two-part epoxy. The adhesive can be used on tile, glass, metal, plaster, concrete, cinderblock, wood and wallboard. It is packaged in a compartmented cup which is used as the mixing container. Each cup holds eight ounces of resin and hardener which are mixed in equal quantities by volume when used. A light coat of the mixture is applied to the surface being mounted to the wall and the object is pressed into place and held for five to ten seconds. The adhesive hardens at room temperature in three to four hours. *Permacel* **P-290**

Gap-Filling Glue

Specially formulated for use where a gap-filling, non-crazing or low-pressure adhesive is desired, F.A. 300 is a high solids liquid urea resin glue. It is said to be especially suited for gluing plastic and hardboard sheets to wood. Features include high strength, water resistance, changeable setting time and low warping tendencies. It can be used in hot, cold or electronic presses. Will give best results when used with a wood having a moisture content between five and 12 per cent. The wood should be free from dust or sanding particles. Resinous woods should be freshly jointed or stored properly so that no resin collects on the surfaces. Very rough surfaces with torn fibers or planer polished surfaces give poor bonds. *National Casein Co.* **P-291**

Fluorescent Adhesive

A harmless fluorescent dye contained in Timbond woodworking resin adhesive permits the detection of adhesive films caused by squeeze-outs, finger prints, etc., before finishing and thus eliminates resanding processes required to remove hidden adhesive films. The dye, which does

not affect the adhesive properties, is added directly to the adhesive before shipment. Invisible to the naked eyes, it shows up only when the product is exposed to an ultraviolet lamp which makes adhesive smudges and smears emit a bright purple glow. A complete line of Timbond Adhesives is offered in densities keyed for specific wood hardness and/or setting speed. *Armour Alliance Industries.* **P-292**

Household Repair Kit

A repair kit for household uses consists of tubes of Liquid Steel, Duro Plastic Aluminum, Duro Plastic Porcelain and other synthetics that will repair anything from a dripping sink faucet to a loose screw in a cupboard drawer. *Woodhill Chemical Co.* **P-293**

High-Solvency Cleaner

A new oil-free, high-solvency cleaner has been designed for the cleaning of metal, glass and masonry building surfaces prior to the application of curtain wall and building maintenance sealers and other two-part liquid polysulfide type sealers. The cleaner, designated Weatherban Brand Cleaner, can also be used for removal of wet polysulfide sealers and priming agents from building surfaces and applicator tools. Because of its oil-free base, the cleaner will not stain surfaces to which it is applied. It is fast acting due to its high solvency and has a flash point above 80°F. The high solvency power permits dissolving of oil, dirt, grease, asphalts, coal tar and other contaminants found on building surfaces and wet polysulfide type building sealers that have been splashed on glass or metal during sealing operations. *Minnesota Mining & Mfg. Co.* **P-294**

Rubber Products Repair Kit

Repairs can be made on conveyor belting and other rubber products with the U.S. Holdtite Belt Repair Kits. The kit consists of various styles and sizes of repair components (rubber and fabric-reinforced patches, sheet material, putties and cements), some simple tools, and an instruction manual. The patching materials are self-vulcanizing compounds that cure at room temperature to a tough, resilient rubber. *United States Rubber Co.* **P-295**

Floor Patch Compound

RIW Epo-Tox, an epoxy-type floor patching and resurfacing compound, is said to have an impact and abrasion resistance five to six times as great as concrete. It may be applied in layers as thin as ⅛ of an inch. It eliminates the need for chipping, jack-hammering and other preparation normally associated with concrete floor repair work. *Toch Brothers* **P-296**

Polymeric Adhesive

Slipping of palletized polyethylene industrial shipping bags can be prevented with PM-22, a water-soluble polymeric adhesive. It will resist horizontal shear and facilitate vertical separation of stacked bags. The product is based on a carboxyl-containing polymer that will not damage printing or stenciling. *Plastics Div., Monsanto Chemical Co.* **P-297**

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ECONOMISTS ARE SOMEWHAT LESS OPTIMISTIC ABOUT BUSINESS now than they were a few months ago. This doesn't mean that they are looking for serious trouble or an early recession. Quite the contrary--they still believe that business will expand and new records will be set. But they don't feel that gains will be as large as originally anticipated. Why? Two reasons: The January stock-market break has raised doubts about an early leveling out. And business has cut bank borrowing--which may mean less inventory buying.

Behind these warning signs, the experts note these factors:
- Inventory rebuilding hasn't been as great as expected after the end of the steel strike. The strike didn't reduce them as much as was believed and they were high at the year-end.
- Sales of new cars are falling short of expectations, despite good Winter sales; stocks are piling up and production rates are being trimmed. So, near-record forecasts may not be met.

All of this is vitally important, because inventory-buying and sales of autos were counted on heavily to lift business.

Here is what analysts in government and industry now think:
- Inventories, which were expected to rise in the first quarter at an annual rate of $10 billion, now may rise only at a rate of $8 billion or so. Next quarter, the rate may be cut more.
- Steel output looked as if it would hold at 90% through June until very recently. Now production may be cut much sooner.
- Auto sales had been expected to hit 7.2 million during 1960. But the talk in Detroit now is of 6.8 to 7.0 million units. But, this still would make 1960 one of the best years ever.
- Business spending for new plant and equipment may not show more than a 10% gain over 1959; 15% had been the forecast.

For the economy as a whole, the experts now are anticipating rises only one-half to two-thirds as much as first predicted.

OFFICIALS IN WASHINGTON AREN'T WORRIED ABOUT A SLOWING in business. Many think it will be a good thing for the country and for most Americans. For one thing, a sharp rise brings with it the danger of a sharp recession. So, a slower upturn holds promise of a longer period of high-level activity. What's more, many of the experts feel business and the stock market should have a period of sobering up, so there will be fewer speculative excesses.

This sobering may also have a healthy effect, longer term, if it serves to puncture the over-optimistic forecasts for the Golden Sixties that are now prevalent. U.S. officials hope so, anyway; they are still worried about inflation.

The U.S. economy is still vulnerable to recession. Total government spending, which stimulates or depresses business, can fluctuate from year to year. Instalment credit is at an unusually high level. And stock market prices can be bid up with money borrowed indirectly. So officials want caution.

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IN B-58 SUPERSONIC BOMBER, B.F.Goodrich high-strength adhesives are used to bond aluminum fuselage, wings and tail surfaces together. In metal laminates, adhesive bonding streamlines appearance, avoids stress concentration, and eliminates corrosion caused by contact of dissimilar metals.

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New uses for high-strength adhesives are constantly being developed as we work with customers to find ways to improve product designs and assembly methods. If you mass-produce a product and think adhesive bonding might improve it, please write and give us full details. *B.F.Goodrich Industrial Products Co., Dept. M-816, Akron 18, Ohio.*

B.F.Goodrich

capitol cues (cont'd)

SMALL COMPANIES INTERESTED IN ENTERING FOREIGN TRADE will receive help from two U.S. agencies--the Small Business Administration and the Department of Commerce. SBA is planning meetings all over the country this year to tell businessmen about world commerce opportunities. The Commerce Department will assemble data from trade missions in many countries; SBA will distribute it.

THE PRODUCTIVITY OF U.S. FACTORY WORKERS IS RISING RAPIDLY these days. For 1960 as a whole, the gains will be substantial, extending those of last year. (In 1959, despite the big strike, output per man-hour in manufacturing rose 7%--largely in the first half.) With wage rates moving up less rapidly than in past expansions, this indicates that business probably can increase its profits this year--even though there'll be less pressure to raise prices.

> For production workers alone--excluding office, sales, and other help--government figures show productivity gains last year were less than those for all workers. Relatively few nonproduction workers have been added to work forces to handle the big output rise of the recovery. In durables, production worker output per man-hour rose 5½%; the increase was only 2% in the nondurables.
>
> The gains in productivity this year will be big, though probably not as great as in December and January, the catch-up period at the end of the steel strike. For 1960 as a whole, you may see gains of 6% or so. But a downturn in business activity later in the year could easily bring a much lower productivity rise.

LABOR'S NEWEST BARGAINING GOAL IS THE AGENCY SHOP, which provides for payment of a "service charge," equivalent to union dues, by nonunion workers. The new steel contract, which set up an agency shop for the first time in that industry, has touched off the drive. Big advantages for the unions is that the agency shop is legal in some states where "right-to-work" laws bar union shops.

COLLECTION OF STATE TAXES ON INTERSTATE BUSINESS is being stepped up by several states--and more are expected to launch collection drives later in 1960. (This is the tax the states are levying on apportioned shares of the profits a firm derives from business within a "foreign" state's borders.) A law by Congress exempted some--but far from all--types of business from this type of state taxation. Some businessmen are reportedly waiting till states bill them; however, this could mean some added expenses in interest and in penalties. Georgia and Louisiana are especially active in collection drives. Nearly 30 states now have laws on the books for taxing interstate profits.

THE DEMOCRATS WILL GET HALF OF THEIR PROGRAM through Congress this year. That's the view of political observers in assessing the chances for the program laid out recently by Senate Majority Leader Johnson and other party chieftains. The Democrats probably will be able to carry out their plan to cut $2 billion or so from Ike's Budget, mainly in foreign aid. Johnson also will be able to push through a big housing bill, a hike in the minimum wage, bigger benefits to social security recipients, a civil rights plan, and more funds for space work.

> It is hard to see where the Democrats will get the strength they would need to pass their bills for hospital care for the aged, a new farm program, aid to education, more money for public works, and more appropriations for the military.

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• For many years, bonded wall tiles, particularly plastic tiles, have been known in the United States and are available in handy packages in almost any hardware store, linoleum store and related outlet. Evidently, use of plastic tiles has not been so widespread in other countries. It seems that the application of these tiles has increased only recently.

In the meantime, American industry has not only developed and improved the plastic wall tiles, but also the application method and the adhesives utilized. This knowledge seems to have been confined to the United States, otherwise it would not have been possible for the *Financial Times,* in London, published on February 24 to state: "A new adhesive which can be used for bonding polystyrene and glass fiberboard tiles, or decorated hardboard panels, to walls, has been developed. The compound, which is composed of a specially developed blend of man-made resins, is said to give exceptionally firm and lasting bond, while at the same time being both easy to apply and very economical to use. The material is said to possess permanent tack gap filling qualities.

"The adhesive is applied in liquid form to the tile or board to be bonded, and quite large tiles of the order of 12 by 12 inches in size require only four daubs of adhesive each about the size of a walnut. It can be used, it is claimed, on all surfaces which are clean, free from oil, grease and moisture."

It seems to us that a number of American manufacturers producing these special adhesives would have an export outlet not only in Britain but also in many parts of Europe. It is quite conceivable that some European factory would be interested in a licensing agreement.

• The British Glue and Gelatine Research Association recently published an interesting promotion article on the use of animal glues. Concerning the glue itself, the association has this to say: "Animal glues have a wide variety of uses which include the sizing of walls, textiles and paper, the stabilization of emulsions and the flocculation of ore suspensions. The major use however continues to be that of sticking things together.

"The term animal glue is normally applied to glues prepared from the skin and bone protein, collagen. Casein glue, although manufactured from milk protein, is not normally described as animal glue. Apart from fish glues, obtained from cod skin, and a small amount of rabbit glue, obtained from rabbit skin, animal glues in Great Britain are made from the bones and skin of cattle and sheep. Accordingly they are divided into two main groups, bone glues and hide glues. These differ as a result of the manufacturing process rather than because of differences between skin and bone protein. In fact it has been found that the chemical composition of collagen, whether obtained from skin or bone is the same for all land mammals.

"Collagen is an insoluble protein which can be broken down by the action of acids, alkalies or heat to form soluble products called gelatine or glue. Skin collagen is normally treated first with lime before being extracted with hot water. The lower temperature extractions then give high grade gelatines. The less pure products are described as technical gelatines or glues, although there is no sharp distinction between the two materials. Bone glues are obtained by the action of steam and hot water on bones that have been treated to remove fat but not mineral matter. Both processes give a wide range of products which differ in molecular weight and in molecular branching. In general, hide glues are of higher grade than bone glues but the ranges overlap considerably. For gluing purposes either type of glue, if the grade is appropriate, is equally satisfactory."

• The leading Swiss automotive paper, *Automobil-Revue,* published in Bern, has disclosed some details on an adhesive which is in the process of development in a special division of the Chrysler Corp. Since 1948, this division has developed and manufactured various adhesives, many of which find use in bonding brake linings to brake shoes. As the result of research, an adhesive has been developed which is supposed to have miraculous properties.

To be introduced commercially within a short period, the adhesive contains a basic material and a hardener. Its performance has been compared with metal and for this reason, it has been named Liquid Iron. Within a temperature range of from 17° to 392°F., all types of material can be bonded including wood, iron, aluminum, brass, porcelain, marble and glass. It takes about 12 hours to cure the adhesive, but with the use of heat, it is possible to reduce the curing time to 20 minutes. No pressure is required and the finished product can be subjected to any finishing operation such as grinding, filing, turning and other metal finishing processes. The bond is said to resist all chemicals and any kind of paint can be used over it.

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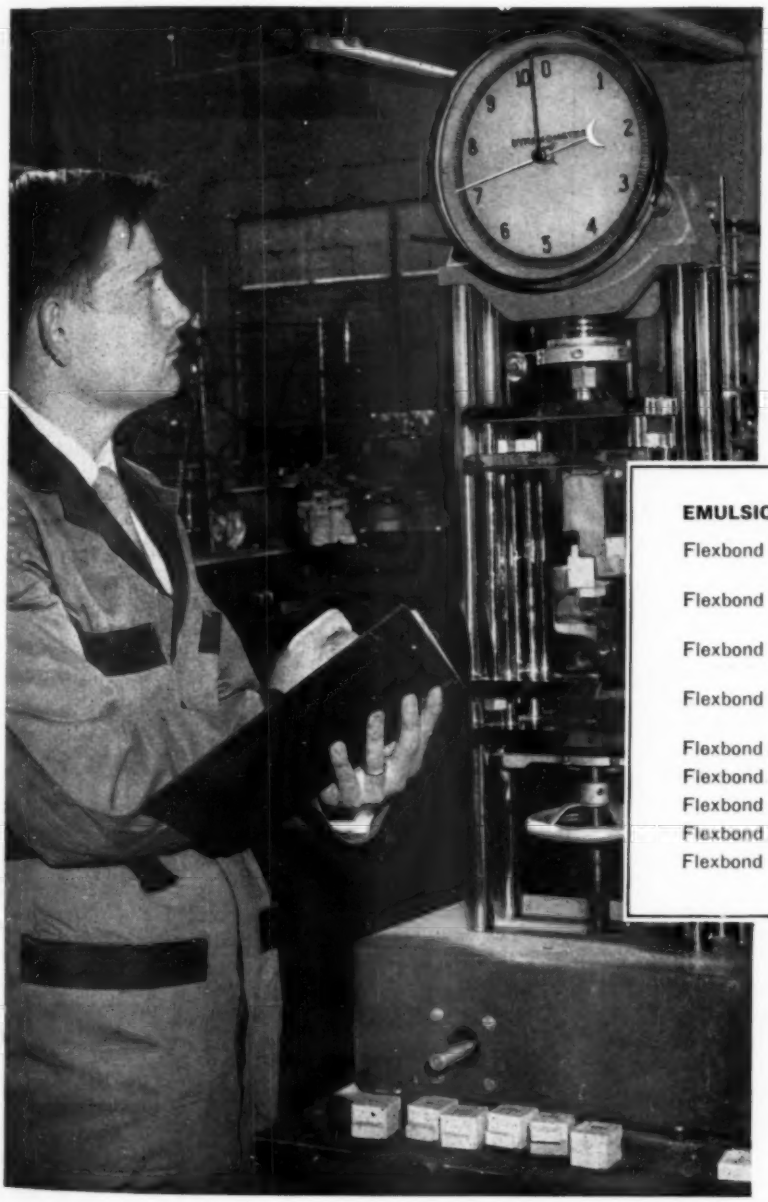

As adherends increase in variety and complexity the adhesives industry is constantly facing new, special problems. Now Colton offers formulators a welcome problem-solver: Flexbond copolymer emulsions. This versatile group assures better results than conventional emulsions because the units needed for special adhesion are permanently incorporated into the polymer chain. Flexbond copolymer emulsions supply flexible, water-resistant bonds.

With Flexbond copolymers even specialized fields of packaging and film lamination can utilize the advantages of acetate emulsions. And many plastic materials previously considered difficult to join now show enhanced adhesion with copolymer emulsions.

The wide range of grades of Flexbond copolymers now available is suggested by the following table:

EMULSION	DESCRIPTION
Flexbond 800	Vinyl acetate—dibutyl maleate copolymer
Flexbond 803	Vinyl acetate—dibutyl maleate copolymer
Flexbond 802	Vinyl acetate—dibutyl maleate copolymer
Flexbond 855	Vinyl acetate—dibutyl maleate terpolymer
Flexbond 306	Vinyl—acrylic terpolymer
Flexbond 100	Vinyl acetate—stearate copolymer
Flexbond 126	Vinyl acetate—stearate copolymer
Flexbond 128	Vinyl acetate—stearate copolymer
Flexbond 165	Vinyl acetate—stearate copolymer

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On the Continent (cont'd)

• The Catalog of Technical Reports, published by the U. S. Department of Commerce contains a list of books and pamphlets which are of interest to the adhesives industry. Included are:

Bearing Strength of Plastic Materials.

Bearing stress-deformation data were obtained on plastic materials to be used in the design of glued or cemented joints. Higher bearing strengths were exhibited by the various laminated thermosetting plastic materials. Bearing strength at 4 per cent deformation of the hole diameter, standard specimen, ranged upward from 4,000 psi for cross-laminated high-strength paper-base phenolic material. There was no specific correlation found between bearing strength and tensile or compressive strength.

Shear Strength of Plastic Materials.

In this investigation, two standard procedures were used. The average ultimate shear strength of the thermosetting plastic materials ranged from 4,400 psi for transparent unfilled allyl derivative type plastic material to about 12,000 to 18,000 psi for the various laminated phenolic paper and fabric-base plastic materials.

Pilot Operations in Development of Processes for Laminating Lumber with Phenol-Type, Low Temperature, Synthetic Glues. This project was undertaken in order to develop a method of laminating lumber for use under extreme conditions of exposure. New manufacturing methods were worked out for new adhesives and new procedures in laminating white oak and later, other materials.

Adhesives.

Solutions of pastes from water-soluble or gelatinous substances suitable for film formation in volatile organic solvents are appropriate as adhesives. The example cited for such substances are: polyvinyl methylether, or ethyleneglycol monomethylether or the polyvinyl ether of ethyleneglycol monomethylether, partially saponified polyvinyl esters as obtained by heating of polyvinyl formate or acetate with mineral acids.

The above may be obtained by writing to the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

• N. V. de Bataafsche Petroleum Maatschappij, The Netherlands, has obtained a British patent whereby epoxy resins are cured by heating with a certain polyalkly hydroxyphenyl chroman derivative at a temperature between 100° and 200°C. The same company prepares epoxy resins according to another patent by reacting a polyhydric phenol with epichlorhydrin in the presence of an alkali, in which a polyalkyl hydroxyphenylchroman derivative containing at least three phenolic hydroxyl groups is used as the phenol.

• In the past, the Department of Commerce has used its trade fair program to win converts in the cold war. Now it wants to win customers for American goods. This policy will get its first big test at the Autumn International Fair in Vienna on September 4 to 11. Private concerns, henceforth, will be permitted to sell goods through the United States Exhibit, which was prohibited in the past. People living in Central Europe did not like, even during very good times, to throw old pots and pans away. They preferred to have them repaired.

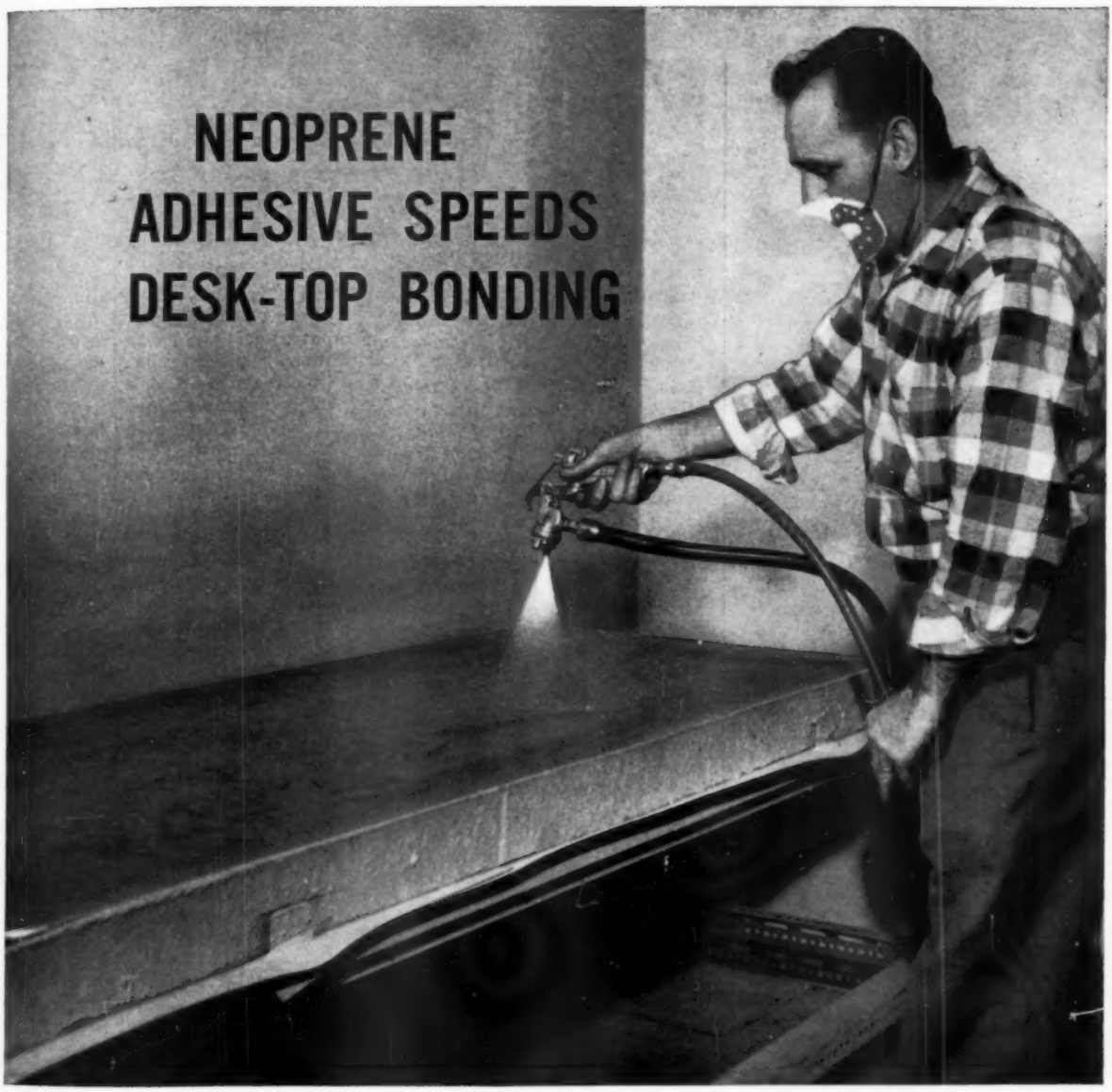
For this reason, a good adhesive which would do the job would sell very well. If such a product is manufactured, it might be advisable to contact the Department of Commerce in order to participate in this first hard-sell exhibit in Vienna. Vienna, the focal point of the Danube Basin, attracts huge crowds from all parts of the neighboring countries. There are quite a number of important industries interested in new adhesives. Americans visiting the Vienna Autumn Fair will have an opportunity to discuss fields of application for their products.

• The German bookbinder journal, *Allgemeiner Anzeiger fuer Buchbindereien,* published in Stuttgart, gives a report on a meeting in New York City of the members of the Bookbinders Guild and representatives of the American adhesives industry. Starting the discussion, Arthur Mayer, one of the industry experts, complained that the bookbinding industry has done nothing in the last 50 years to improve its manufacturing methods.

Mr. Mayer cited the envelope industry, which has increased its production rate from 130 envelopes per minute to 900 in the last 25 years. He pointed out that "in a very short time the manufacture of book covers as we know them now will be obsolete and they will be replaced by a plastic material which can be fastened to the book with a very simple electronic tool."

Another expert criticized bookbinders for being reluctant to develop efficient production methods. Bookbinders, he said, are satisfied to use glues and adhesives which are obsolete and old fashioned. Martin Blumberg of the American Book-Stratford Press, pointed out that bookbinders are choked with adhesives of many kinds. Very seldom does a bookbinder receive precise instructions concerning the character of adhesives, he said. He has no test or control facilities for the various papers which he is supposed to process.

After having outlined problems in binding books originating in various shops which use different materials, two other bookbinders pointed out that it is impossible to stop machines to start analyzing every order and, furthermore, to invite chemists of the adhesives manufacturers to advise them on how to proceed. How about giving the American bookbinders more information on adhesives?



An East Coast manufacturer of nationally known steel office furniture has discovered that a neoprene adhesive is excellent for bonding linoleum tops to steel office desks.

Contact bond-type neoprene adhesive was selected because it dries faster, speeds production, has better adhesive qualities and works better under fast-dry conditions. Furthermore, this adhesive has good sprayability . . . it goes further . . . does more work at less cost per gallon.

Neoprene adhesives can also be used for fabricating plastic-faced cabinets, interior partitions, school furniture, and other metal products, since they will securely bond rigid decorative plastic laminates not only to steel but to hardboard, honeycomb, and other core materials.

For more details on how versatile neoprene adhesives can cut costs in *your* business, contact your nearest adhesives supplier. A list of suppliers is available from E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Department **AA-4,** Wilmington 98, Delaware.

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letters to the editor

Adhesive Bond Failure

Editor's Note: The March 1960, issue of ADHESIVES AGE *featured an article on "Adhesional and Cohesional Failures in Adhesive Bonds" by J. F. Murphy, chief of the Chemistry Section of the Metallurgical Laboratories, Olin Mathieson Chemical Corp., New Haven, Conn. In this article Mr. Murphy pointed out that in his discussions of bond failure, J. J. Bikerman, Massachusetts Institute of Technology, Cambridge, Mass., employs a definition of an adhesive failure as one in which the rupture occurs between the adhesive and adherend.*

To fit such a definition, one or part of one or both of the surfaces produced in bond failure should be completely free of adhesive, Mr. Murphy noted. Using this definition, he pointed out, it is probably correct to say that adhesive failure never occurs. He went on to say that while this conclusion is valid, it was misleading in that it implied that the problems involved in adhesive-adherend interaction are trivial, and that to avoid such misleading implications it was necessary to employ a different definition of an adhesive failure. Mr. Murphy concluded that more investigation of the reasons for defects in the interfacial layers was vitally important.

In the letter printed below, Mr. Bikerman discusses some of these objections.

(1) I was gratified to read that "it is probably correct to say that adhesive failure never occurs." This being so, the molecular forces between unchanged adherend and unchanged adhesive are irrelevant. This conclusion probably will appear more convincing if supported by analogy with a less controversial reasoning, namely: When an organic adhesive is mechanically ruptured, no splitting of the carbon atoms in it takes place; hence, forces holding a carbon atom together are of no concern to the adhesive chemist.

However, it would be wrong to consider "the problems involved in adhesive-adherend interaction" as "trivial". Such an interaction can, and often does, result in formation of weak boundary layers, *i.e.*, of improper joints. In this manner the strength of a joint may be reduced by a factor of 10 or even 100; certainly, no trivial effect.

(2) When physical chemistry of surfaces is applied to the problem of adhesive joints, roughness of all solid surfaces (reviewed, for instance, in reference *1*) must be taken into account.

(3) After the publication of my papers referred to in Mr. Murphy's article, some progress has been made and, I believe, has clarified some of the points mentioned in the article. Because of the significant depth of interfacial layers, rupture can readily occur in them.

An example of this rupture was found in polyethylene joints, and a method of transforming an improper into a proper joint by removing substances which give rise to a weak boundary layer was described in reference *2*. An instance of apparently adhesional failure which was caused by stress concentration at the adherend-adhesive interface was published in reference *3*. A review of our theory (in its application to glass) can be found in reference *4*. A more detailed report (*5*) has just been published.

Finally, a book on "The Science of Adhesive Joints" is in press and, I hope, will make our viewpoint unmistakable. I should like to add here that references *3* to *5* probably appeared after the completion of Mr. Murphy's article and thus could not be known to him.

J. J. Bikerman
Massachusetts Institute of Technology
Cambridge 39, Mass.

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(1) J. J. Bikerman, "Surface Chemistry," 2nd ed., Academic Press (1959).
(2) J. J. Bikerman, *Adhesives Age*, Vol. 2, p. 23 (1959).
(3) J. J. Bikerman, *J. Appl. Polymer Sci.*, Vol. 2, p. 216 (1959).
(4) J. J. Bikerman and F. J. McGarry, *Glass Industry*, Vol. 40, p. 525 (1959).
(5) J. J. Bikerman in F. Eirich's "Rheology," Vol. 3, p. 479 (1960).

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Use of an abrasive-adhesive mixture to provide additional traction over slippery expansion joints on the San Francisco-Oakland Bay Bridge is providing safer driving for 107,000 automobilists daily.

In recent years, accident prevention studies have shown that a large percentage of annual smashups can be attributed to specific roadway danger spots. As a result, highway engineers have been testing various ways to eliminate many of these hazards.

California's Division of Highways recognized such a hazard on the Oakland Bay Bridge where steel expansion joints across the width of the roadway became extremely slick in wet weather. The problem was aggravated by the fact that because the bridge is a major commuter artery, traffic often becomes congested and drivers have to use their brakes frequently.

To provide additional gripping power on these metal expansion joints, the Division of Highways has developed a technique of coating the surface of the metal with an abrasive grit that permits the joints to offer as much traction as the rest of the roadway. The technique is essentially that of cementing aluminum oxide granules onto the metal area with a polysulfide-epoxy adhesive.

Expansion joints along the bridge range in size from five to about 16 feet wide and run the full width of the 58-foot roadway. In order to coat the joints without tying up traffic, a single lane at a time was closed for about four hours.

To assure a good adhesive bond, the steel surfaces of the joints were first sandblasted by two workers in protective clothing. Then the polysulfide-epoxy adhesive, a free-flowing liquid, was applied with heavy paint rollers and aluminum oxide grit to a thickness of ⅛th of an inch poured on.

"Ovens" Speed Core

Drying of the adhesive is accelerated by placing metal "ovens" over the prepared surface. The ovens are heated with propane burners and remain in place for 90 minutes. After they have been removed, the application is allowed to harden in the air for an equal amount of time before the lane is re-opened to traffic.

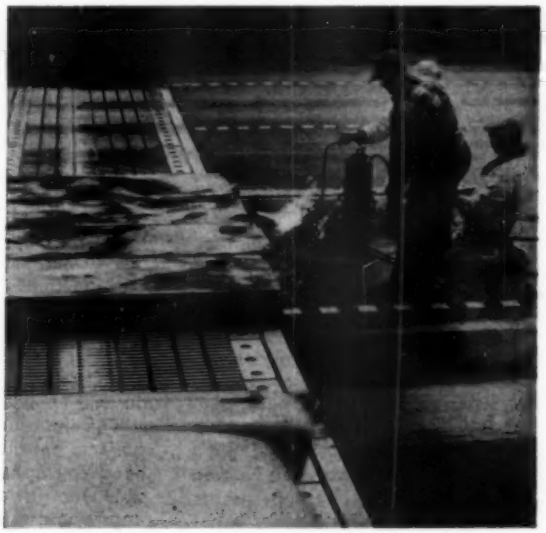
A Division of Highways spokesman reports that after 45 days in service, the first abrasive-adhesive application lost one per cent of its grit due to traffic wear. Subsequent applications were improved by rounding the surface edges so that the adhesive covers about 1/16th of an inch down on each finger. This provides an "inter-locking" support grit on the edges.

The California department had done considerable work with polysulfide modified epoxy resins before this particular application. For example, pre-molded concrete blocks have been cemented to concrete highways, lane buttons have been bonded in place and new concrete patches have been laid over old sections with similar adhesive formulations.

According to technical literature released by Thiokol Chemical Corp., producer of polysulfide liquid polymers, adhesives modified in this way have higher elongation, greater impact resistance and less brittleness. In addition, they are better able to withstand many freeze-thaw cycles as well as exposure to temperatures over the boiling point.

Joint surfaces are sandblasted to achieve a long-lasting bond of the polysulfide-epoxy adhesive into which the aluminum oxide grit will be poured to a ⅛"-thickness.

After the workers on the right apply the adhesive formulation with paint rollers, the Alundum grits are poured on through a funnel. In all, 8000 square feet will be covered.



The normal four-hour drying time is cut by about half through the use of metal "ovens" to speed the adhesive cure. Gas torches supply the necessary heat.

Close-up of a coated section shows how much added traction will be gained for automobilists. The adhesive formulation used has both high tensile and compression strength.

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Ionizing radiation used in

Making Fluorocarbons Adhesionable

Modification of the surface qualities of polyesters and fluorocarbons by ionizing radiation is making it commercially feasible to bond these non-wettable plastics by conventional adhesive techniques.

In the early 1950's, General Electric introduced the first commercial application of atomic and ionizing radiation—Irrathene, an irradiated cross-linked polyethylene. Since then, design engineers, chemists, managers, and material users have been seeking to apply this powerful tool to their specific problems. Now users and suppliers of adhesives can reap the benefits of ionizing radiation as the result of recently perfected techniques for industrial graft copolymerization

The term "graft copolymerization" is applied to the process of polymerizing monomer A onto polymer B so that polymer A constitutes a "branch" on a "trunk" of polymer B. These techniques can be used to impart hydrophilic properties to normally hydrophobic plastics. They can also be used to increase surface *polarity*, thus creating permanently anti-static surfaces.

By using this technique to increase the *affinity* of plastic surfaces for other non-polar substances, non-wettable materials, such as polyesters and fluorocarbons, can be modified so that they will be wetted by conventional adhesives. This was noted as far back as 1953, in J. A. Goodman's work on grafting polyvinyl acetate to Teflon (*Research* Vol. 6, p. 428 (1953)). This particular graft was reported to modify the tackiness and adhesion properties of Teflon.

Radiation Applications Incorporated recognized the commercial potentialities of radiation-induced copolymerization in 1957.

At that time, an RAI technical publication noted that, "The ability markedly to affect the properties of a polymer by the grafting of relatively small amounts of another substance, coupled with the important fact that grafting can be performed on polymers both in the raw and fabricated stages, holds forth good promise for eventual widespread industrial application."

The importance of being able to graft to fabricated products cannot be over-emphasized. It makes possible the introduction of property improvements without affecting processing characteristics or costs.

An interesting application of grafting techniques, and one of the first fully commercial applications of this type of radiation processing was RAI's development of their Raibond process. This process imparts a bondable surface to fluorocarbons through the combined use of ionizing radiation and chemical techniques.

Early workers in the field of radiation chemistry attempted to use ionizing radiation to degrade the surface of materials such as Teflon, so as to form a bondable surface. This action is similar to the action of conventional "etching" solutions in that the carbonfluorine bonds are broken, leaving a carbonaceous surface. However, the amounts of radiation which are needed, usually in excess of ten million roentgen, also completely degrade the mechanical and physical properties of Teflon.

Even after researchers in several laboratories, such as those at Brookhaven, discovered the techniques of grafting, these processes remained mere laboratory curiosities. At this point, several commercially oriented research and development companies, such as RAI, started to investigate possible commercial applications of grafting techniques.

Contact with representatives of DuPont convinced RAI that there was a real need for better bondable fluorocarbon surfaces. Conventional techniques had several drawbacks:

(1) The Teflon was discolored.

(2) The surface resistivity of wire insulation was often decreased.

(3) The adhesive bonds did not stand up in prolonged sunlight.

(4) The techniques used were difficult, costly, and hazardous.

Scientific Challenge

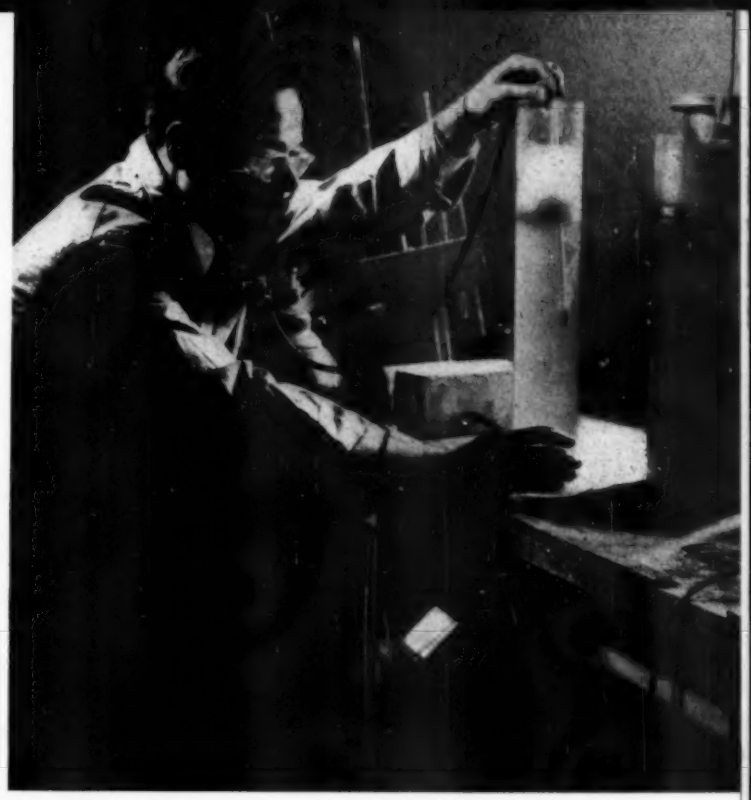
Thus the challenge posed to RAI scientists was to develop a wettable Teflon graft, without adversely affecting the color, stability and electrical properties of the virgin polymer. In addition, the radiation doses had to be kept to a minimum to avoid degradation.

Many of the grafts reported in the literature were investigated in the RAI laboratory—but all failed to meet the above parameters in one or more ways. If the graft was too polar, the surface resistivity dropped, depriving the Teflon insulation of one of its main advantages. Other grafts impaired the chemical and thermal stability of Teflon. Yet another graft showed excellent bondability and chemical resistance but stiffened the Teflon. This graft discolored at temperatures above 130°C., a factor which ruled out its use for wire insulation—where the retention of the original color at all temperatures up to 250°C. is important.

One particular graft did have the required physical, chemical,

About the Author . . .

HOWARD STERN has been active in work on silicones, high - temperature materials and graft copolymerization. He is a graduate of M.I.T., where he received B.S. and M.S. degrees in Chemical Engineering Practice.



Preparations for radiation modification of fluorocarbon insulation are shown above. The RAI project engineer is sparging the monomer in which the tape will float during exposure. In the photo on left, the Cobalt-60 radiation source is lowered into the exposure chamber.

mechanical and electrical properties. This graft required a minimum radiation dose, thereby making any possible radiation degradation unobservable. After this graft had been prepared on a test tube scale, there was the problem of scale up.

Scale up required the development of techniques which were unique to the plastics and chemical industry. Radiation polymerization is severely inhibited by the presence of oxygen; therefore, an oxygen free apparatus had to be devised. The radiation step was fairly lengthy; therefore, a batch type operation had to be combined with continuous material handling techniques.

Since one of the major applications of our new process, which we dubbed Raibond, is to Teflon insulated wire, specialized wire handling techniques had to be developed. A Cobalt 60 source of optimum design for this type of process had to be designed. In addition, since RAI does not fabricate wire or other articles from Teflon, close liaison had to be established between RAI and the Teflon industry.

The resulting products of the Raibond process had to be thoroughly tested and evaluated for all of its potential applications. Since radiation is known to degrade Teflon, thorough testing was necessary to ensure the meeting of all military and civilian specifications. And, of course, the properties of the adhesive bonds which resulted had to be checked and double checked.

The graft system thus developed forms exceptionally strong adhesive bonds with all epoxies under shear and with a large variety of epoxies when tested for peel. When properly primed, the Raibond surfaces show excellent adhesive bonds with Room Temperature Vulcanizing silicone rubbers. In fact, often the adhesive strengths are greater than the cohesive strength of the RTV silicone rubbers.

Sealing Processed Teflon

Raibond processed Teflon can be hermetically sealed when used with RTV silicone rubbers. RTV silicones are used as adhesives, or caulking compounds, in systems compelled to withstand extreme ranges of temperature. For example, an epoxy adhesive which was used to bond a Teflon plug into a microwave guide cracked when cycled once between −65°C. and room temperature. A Raibond treated Teflon plug which was bonded in the wave guide with an RTV silicone rubber did not crack when subjected to 24 cycles between −65°C. and 100°C. The rubber acted as a flexible caulking compound, and the hermetic seal was maintained.

There are many other possible applications of radiation-induced graft copolymerization, *e.g.*, to impart bondable surfaces to polyesters such as Mylar. Polyolefins and polyamides—nylon—can also be modified so as to impart desirable surface characteristics.

In short, a new technique has been developed which gives the design engineer much wider latitude in the selection and use of plastic materials. Radiation-induced graft copolymerization can be utilized whenever it is desired to modify the surface of a material without changing its bulk characteristics. Each new application will undoubtedly entail some, if not a great deal of, developmental effort; but the rewards are there in the form of increased versatility and utility of polymeric materials.

Chemists and chemical engineers now have one more tool with which they can tailor-make plastics to the needs of industry.

By EDWARD V. HUDA
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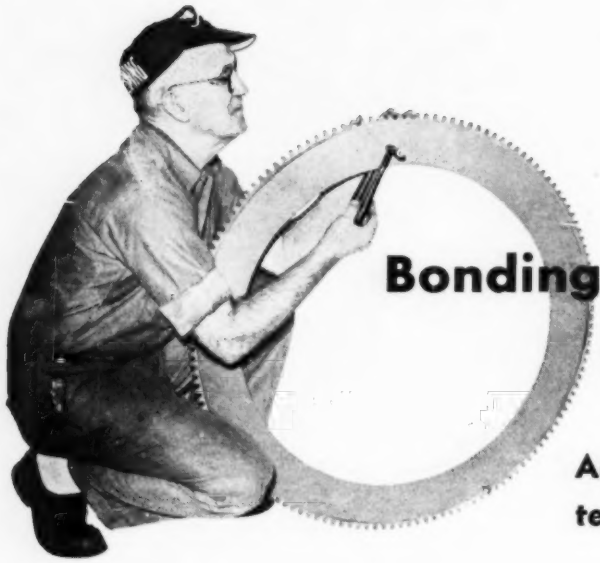

Bonding Friction Materials to Metals

Adhesive methods replace outmoded techniques based on use of rivets

For some twenty-odd years, Raybestos-Manhattan has been bonding friction materials to metal and molded members. The company was the first of the friction material manufacturers to go into bonding. Though our initial use of the process was a matter of necessity, the parts to be processed at the time were too thin to be riveted, as time progressed other parts of various thicknesses were bonded rather than riveted to profit from the advantage of bonding over other fastening devices.

The advantages are numerous, but the three that most affected Raybestos were cost of manufacture, the elimination of rivet holes which became filled with abrasive that scored the mating members, and the additional service life of the part.

At this point it might be best to give a brief history of bonding at Raybestos. Prior to World War II, a friction material was developed for the military for use in a Navy Supercharger. The final assembly was to consist of a steel core, approximately .070″ thick, with a spline on the inside diameter and two facings, approximately .020″ thick, laminated on each side. From the thickness given it can be seen that riveting would be impossible.

Several years later, Raybestos developed a semi-metallic material for use in oil for the friction plates in automatic transmissions. These assemblies were larger in diameter but similar to the part for the Supercharger. Two facings, .033″ thick, had to be attached to each side of a steel plate, also .033″ thick. As time progressed, combinations of paper and cork were used for some transmission plates. Today, depending on the transmission, the bonded assembly may contain semi-metallic combinations of cork and paper, or all paper. The paper referred to is a specially processed asbestos product.

In another application, just after the war we started bonding clutch facings to steel plates and brake linings to steel shoes.

From the very beginning, Raybestos developed its own adhesives. We knew the stresses, strains, temperatures, etc., encountered in the field and developed adhesives to do the job. Initially we used a specially formulated phenolic base adhesive. After the war, we were introduced to a nitrile rubber-phenolic product, which we thought to be ideal for our use. It had less plastic flow, which would allow parts without intimate contact to be bonded. In addition it was flexible, which meant that the assembly might be able to withstand greater shock loads.

Heat Limitations

We were advised by one customer to use such an adhesive on one transmission part. We also evaluated the same adhesive on a small quantity of heavy duty clutch assemblies. We soon learned that a nitrile rubber-phenolic adhesive had its limitations, mainly, heat limitations. As a result, we now first ask the maximum anticipated temperature before selecting a nitrile rubber-phenolic adhesive. Our point of separation is 400°F. If a part is to be subjected to 400°F. for any period of time, we select a phenolic base material for use in the adhesive.

Knowing the shortcomings of the formulation available at the time, we set to work to develop a similar product but one with higher strength properties at all temperatures up to 600°F. We kept the maximum operating temperature the same but ended up with a product with a much greater safety factor. These two, then (the nitrile rubber-phenolic and straight phenolic adhesives) are the ones used at Raybestos for the bonding of friction materials.

Let us examine the properties of these adhesives as demonstrated by the various tests used at Raybestos. We run disc shear tests on all adhesives for bonding friction materials. For special data, such as production control checks, we run button tensile, aluminum tensile and flow tests. As the adhesives used are of the heat-setting type, the test assemblies are all bonded with both heat and pressure.

The disc shear test assembly consists of a steel disc, 1-⅛″ in diameter by ¼″ thick, bonded to a steel plate, 1-⅛″ wide by ¼″ thick. The test pieces are subjected to a selected temperature for one hour and pressure applied while the assembly is at temperature until failure of the specimens.

The button tensile assembly consists of two steel buttons with a bonding area of one square inch, bonded together. The buttons are subjected to the desired test temperature for

Over-all view of the production setup for bonding friction materials. Note oven-conveyor system at top of photo. Before beginning production on an item, extensive tests are run to see if the bonding technique and adhesive chosen will provide satisfactory performance under conditions the product can expect to meet in use. For over more than 20 years, Raybestos-Manhattan has perfected its techniques for bonding friction materials to metal and molded members.

one hour, and then pulled in tension while at temperature until the bond failed.

The aluminum tensile test consists of two pieces of .064″ 2024ST aluminum strips one inch wide bonded together with a one-half inch overlap. The parts are pulled in tension until failure.

Production Control Tests

These tests are our production control tests. They also tell what an adhesive will do in application.

As the name indicates, the flow test gives us an idea of the amount of plastic flow to expect and whether the adhesive was prepared properly to give the desired flow properties. It will also tell if an adhesive is usable after it has been stored for a period of time. We set a minimum flow of 130 per cent on a virgin batch of nitrile rubber-phenolic adhesive. As storage life increases, the flow decreases.

The flow is obtained by laying a film of adhesive thick enough to give a dry film thickness of .010″. A 1-⅛″ diameter disc is punched from the film and placed between two pieces of cellophane. The film and cellophane are then placed between two plates. One hundred pounds per square inch is applied and the assembly is placed in an oven at a specified temperature for a given period of time. The part is then disassembled, the area of the film is measured with a Planimeter, and the per cent increase in flow is calculated by the researchers.

Let us examine the strength values which Raybestos-Manhattan requires of the adhesive used to bond friction materials. For example, with our phenolic base adhesive, we require the following minimum values using the disc shear method:

At room temperature, the shear strength must exceed 2450 psi.

At 400°F., the shear strength must be greater than 2000 psi.

At 600°F., it must exceed 1500 psi.

This type of adhesive is used on all parts for heavy duty and high temperature applications. The limitations for such an adhesive are that the parts must have intimate contact with the metal member to which they are to be bonded.

The minimum strength values for a sprayable type nitrile rubber-phenolic adhesive using the disc shear tests are as follows: room temperature—2000 psi; 400°F.—900 psi; 600°F.—450 psi.

The minimum button tensile requirements are: room temperature—1900 psi; 400°F.—800 psi.

The minimum aluminum tensile strength is 2200 psi.

The minimum shear strength values for a higher viscosity extrudable type nitrile rubber-phenolic adhesive recommended for bonding brake linings to steel shoes are as follows: room temperature—2000 psi; 400°F.—900 psi; 600°F.—450 psi.

The minimum button tensile requirements are as follows: room temperature—1750 psi; 400°F.—800 psi.

Top photo shows how segments are aligned to insure proper positioning. Below, hot press bonding where parts are too large for multiple grouping in packs.

About the Author . . .

EDWARD V. HUDA is the project supervisor for the Adhesives Dept. of Raybestos-Manhattan, Inc. He is in charge of research and development. A member of ASTM's D-14 Committee on Adhesives and of the Society of Automotive Engineer's special committee for evaluating adhesives for brake linings, Mr. Huda has been with R-M since 1948. He is a graduate of Pratt Institute of Technology.

The minimum aluminum tensile strength is 1750 pounds psi.

It might be worth noting at this time that although the straight phenolic type products show excellent heat strength properties, they are not suitable for metal-to-metal bonds. They are too brittle for this use. Phenolic base adhesives are suitable for use in friction material bonding because one of the members is somewhat porous.

The additional tests (button and aluminum tensile) are run on the nitrile rubber-phenolic adhesive because properties other than shear strength—flexibility, for example—are desired. If the wrong resin to rubber ratio were used or too little or too much sulfur and accelerator used, it would be detected by the values obtained by the button and aluminum tensile values. All of these tests are production control tests now; however, prior to our entry into the field of manufacturing adhesives, we used these tests to screen materials submitted by various adhesive manufacturers.

Various Resistance Tests

Besides strength and heat resistance, we must have resistance to any materials that the bonded assembly will or might come into contact with in application. Some of these would be lubricating oils and greases, brake fluids, transmission oils, water, solvents, etc. In addition to heat resistance and chemical resistance, the adhesives must be able to function properly at sub-zero temperatures. To date, this has never been a problem with us.

Converting to bonding friction materials did, however, present some basic problems:

(a) How to make the parts stick together and stay stuck in application.

(b) How to make them economically.

Companies doing any amount of bonding generally have some bond failures and field delamination. Because of our experience, we were often requested to supply assistance to customers who wanted to do their own bonding. This helped expedite our education.

We soon found out that the critical part of bonding is surface preparation and surface condition. They are actually two separate items as properly prepared surfaces are often not in the proper condition when they are bonded.

We try to sand or shotblast whenever possible. If the parts will warp by sandblasting, we etch chemically. We first got into chemical etching with the automatic transmission parts.

As was pointed out previously, the initial assemblies consisted of two .033″-thick semi-metallic facings bonded to a steel core .033″ thick. The test for a bond was to bend the facings 180° over a one-half-inch-diameter rod. At the bend, there had to be friction material showing on 100 per cent of the area. No steel areas could be visible.

This test was specified because in application the facings would dish or oil can. If the assemblies would take a 180° bend, they would surely take the dishing. We initially had to test 2 per cent of our work. Later, it was cut to one-tenth of one percent of all work done.

To pass such a test, we had to have a surface similar to a sandblasted surface. To get such a surface—without warping the part—we had to use chemical etching.

One problem of the utmost importance was smut removal. This problem increased as the carbon content of the steel cores increased. The answer was electrolytically reverse current cleaning. Unless the smut was completely removed, the strength of the bond was only as strong as the adherence of the smut to the steel.

Regarding the economics of manufacture, we found our answers in the use of automatic spray equipment, pack bonding, conveyor ovens, and induction heating.

Aside from just knowing the strength properties of the adhesives, other tests are run before a final decision is made for a bonded assembly. Knowing the technique of obtaining a good surface and selecting an adhesive with theoretically sufficient strength and heat resistance is only part of the problem. The assembly still has to work in application.

Normally tests will be set up to give the most extreme conditions that the bonded assembly will be subjected to. If they perform satisfactorily under these conditions then they will certainly perform satisfactorily under normal conditions. If tests can be run in our plant, we do so, if not, the customer will do the testing. Most always the customer will want to do his own testing regardless of the tests we run.

Bonding Vs. Riveting

For better comparison of a bonded versus riveted assembly, let us examine something familiar to almost everyone—a brake assembly. In a lining with a long arc of 11½″, 2″ wide, 10 rivets, approximately .320″ long and .141″ in diameter are used. These rivets have a shear strength of approximately 860 pounds at room temperature, 720 pounds at 400°F. and 642 pounds at 600°F.

However, the strength of the assembly cannot be determined by multiplying the rivet strength by the number of rivets. Another factor enters the picture—the strength of the lining at the various temperatures.

Brake linings are made of organic binders and have some thermoplastic tendencies. One of the strongest types of linings, for example, has a shear strength of 450 psi via the disc shear technique. Let us use this value and assume there is no additional softening beyond 400°F.

The load to break the assembly, taking the rivet strength only, will be 8600 pounds at room temperature. For a bonded assembly, assuming only one-half the area of the inside arc (11″ long) is coated with adhesive, 20,000 pounds will be required to break the assembly. Of

course, this is disregarding the strength of the friction material.

At 400°F., with a material strength of 450 psi, we have an available bond strength of 900 x 11 or 9900 pounds, a safety factor of over two to one. Even at 600°F., disregarding any additional softening of the lining beyond 400°F., safety factor is available.

As an added factor, the bonded area will be greater than the area originally covered with the adhesive, since we disregarded any plastic flow during the bonding operation. In addition, the above values were given without regard to another force that will decrease the actual shear force on the lining *i.e.*, the force applied in application by the drum against the lining. The latter, in turn, forces the lining to the shoe.

Bond Line Temperatures

In considering temperatures, it might be worth giving some bond line temperatures possible under various conditions. For example, a trip through the center of a city as large as Bridgeport might get the temperature up to 270°F., normal driving in a large city might give a bond line temperature of 380° to 390°F. Normal driving on a freeway might give a bond line temperature of 400° to 430°F. Braking a car down a mountain might give a bond line temperature of 450° to 470°F.

Much higher temperatures are encountered in clutches for heavier units such as industrial earth-moving equipment, for example. It is possible to bring the drive plate to a red heat. For such applications, the normal adhesive used for the bonding of linings to shoes will not suffice and special formulations are needed.

Rocker Panel Rebuilt

Unique use of a steel-epoxy compound helps repair an automobile panel corroded by 73,000 miles of driving

An automobile panel, corroded and eaten away after 73,000 miles of driving, was completely repaired with an unusual compound of finely powdered steel and epoxy resin.

The repair job was done on a 1950 Buick Riviera owned by Joe Sirianni, partner of the Dutch Parking Station Co., New York, N.Y., who described the process as follows:

First the corroded section and other loose surfaces as well as grease and paint were removed. The area was then thoroughly dried and then roughened with emery paper. Next, a screening was secured over the damaged area by means of a few dabs of the steel-epoxy mixture, manufactured by Devcon Corp. and known commercially as Plastic Steel. The base compound was mixed with its hardening agent and applied over the screen with a putty knife.

Because the work was done in an unheated area, drying was accelerated with heat lamps. When the new surface was completely hard, the entire area was finished with a sander and then painted to blend in with the body of the automobile.

The corroded rocker panel of a Buick driven over 73,000 miles was completely repaired, photo right, by a mixture of powdered steel and epoxy resin.

By R. J. SCHUTZ and A. G. VAN HAUTER
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A Joint Sealant Testing Machine

With the advent of the new elastomeric-type sealants and improvements in the conventional mastic-type sealants, available testing machines could not provide the necessary information for complete evaluation of all the qualities of the joint sealants.

To successfully evaluate the new type joints, it is desirable to have a machine capable of performing the following functions:

(1) *Extension test:* The standard compliance test (extend a one-in. joint at the rate of ½ in. in four hours), Federal Specification SSR-406-C.

(2) *Compression test:* As concrete expands, joint sealants are compressed. A test cycle involving measured compression is highly desirable since the reaction of the material to compressive loads may conceivably affect the integrity of the joint.

(3) *Variable rates of load application:* Certain joints similar to those in bridge decks are subject to more rapid movement than those prescribed by Federal specifications. Therefore, a machine used as a research tool should be able to apply loads at a variety of rates if actual field conditions are to be simulated.

(4) *Force necessary for extension and compression:* Since adhesive and cohesive characteristics of sealants may vary independently with temperature changes, it is necessary to measure forces under varying conditions if success of sealant in the field is to be adequately predicted.

(5) *Test for maximum extension:* These data are necessary to design joints using the method described by Egon Tons in his paper presented at the Highway Research Board meeting in January, 1959.

Length of Service

(6) *Fatigue failure:* How long a joint sealant will continue to serve its purpose is a significant factor in determining its economy. By repeated cycles of compression and tension under controlled conditions the life of a sealant can be accurately predicted.

(7) *Environmental testing:* Since joints will be subject to a wide range of climatic conditions, a testing machine should be capable of performing the above tests under a wide range of temperature and humidity conditions.

The testing machine (see Figure 1) described in this article meets these requirements. Essentially, the unit consists of the following elements: power source, chain drive, gear-reducing system, driving screws and loading heads, recording devices, and carrying frame. The machine weighs about 600 lbs., is 24 inches wide, 38 inches long, and 32 inches high. It is mounted on wheels for mobility.

The load is applied through six moving heads arranged in two rows of three each. Specimens prepared as prescribed by ASSHO specifications are clamped between the fixed head and the moving head. When the motor is turned on, the head fixed to the driving screw moves in one direction or the other, as required, thereby applying either a compressive or tensile load. See Figure 2.

As the test proceeds, an actuating arm moves in the same direction as the driving screw. This arm, after a present distance of travel, trips a reversing switch which changes the direction of rotation of the motor and thereby the direction of the loading. Although present models of the machine are not so equipped, a counting device could be attached to the testing table to record the number of load cycles.

Each of the moving heads is equipped with a deflection plate attached to a lever arm which in turn moves a separate load indicator, calibrated in pounds. Scales on the indicators are calibrated for the three ranges of deflection plates used and are read directly. Each one of the indicators is equipped with a recording needle which automatically indicates the maximum load at failure.

The power source is a 1750-rpm, ¼-hp, electric motor (Figure 3). Direct gearing reduces the speed to 1 rpm. The chain drive to the specimen-head driving screw reduces the ratio further to 2 revolutions per hour; the screw, having a pitch of 16 turns per inch, gives the required ⅛ inch travel per hour. The entire unit is a chain and gear linkage,

About the Authors . . .

RAYMOND J. SCHUTZ, vice-president of Sika, is active in developing improved methods of construction. A member of ASTM's Committee C-9 and the Ad Hoch Committee on Epoxy Resins, Mr. Schutz has lectured at various colleges.

ALBERT G. VAN HAUTER is chief of the Mechanical Department, Engineering Laboratories, Sika Chemical Corporation. An associate member of the Hudson County Society of Professional Engineers, he designs specialized test equipment.

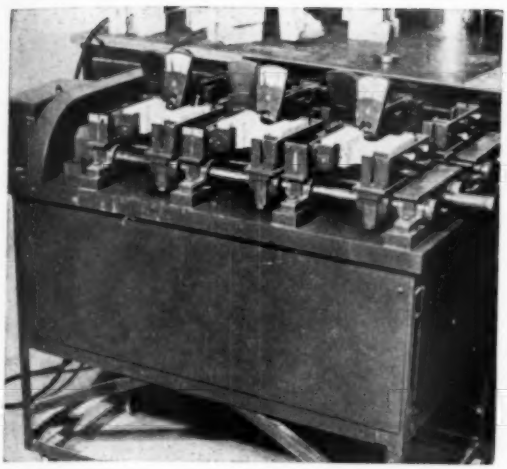


FIG. 1. Photo on extreme left shows unit which will test up to six specimens simultaneously. Three are shown here. Failure of one does not affect others.

FIG. 2. Arrangement of testing heads for single specimen is shown left. Deflection plate and lever arm in left head activates load gage to the rear.

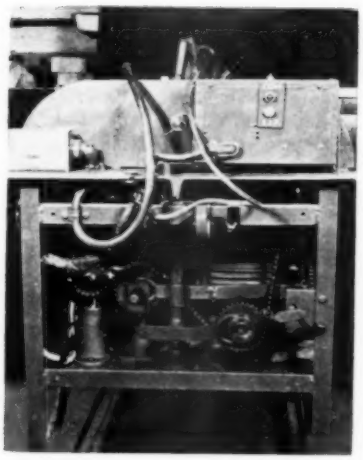
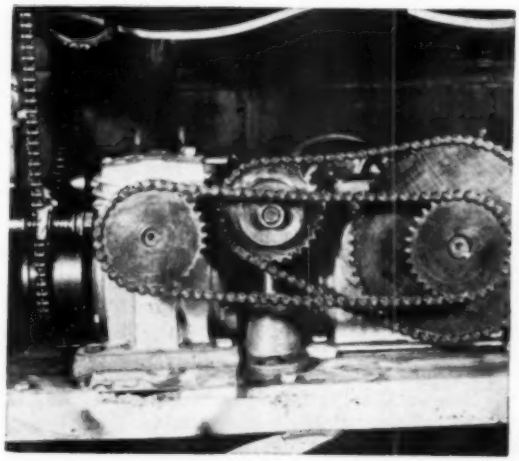


FIG. 3. Electric motor in photo right is mounted directly beneath testing table. Travel direction is reversed by tripping reversing switch on table.

FIG. 4. View of motor on far right shows how power takeoff is reduced through chain and gear linkage. There is no slippage or speed variation when reversing.



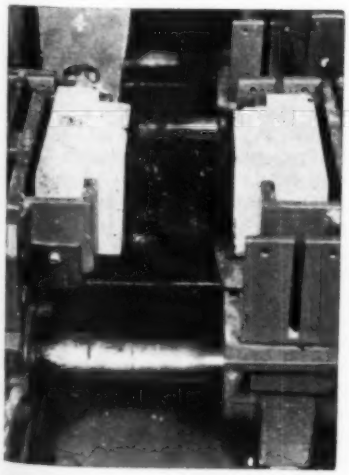


FIG. 5. Full extension of the head shows cohesive failure of the mastic sealant being tested. Machine will record load at which this failure occurred.

FIG. 6. Test to failure of mastic joint sealer indicates that the tensile strength of the material exceeds its bond to concrete. Unit provides new design data.

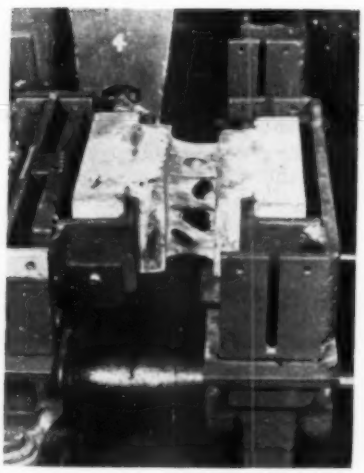


FIG. 7. Though the bond above is unbroken, internal stress failure has progressed to the point where the epoxy material would no longer serve as a sealant.

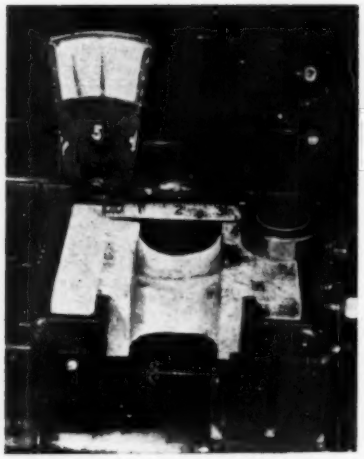


FIG. 8. Successful test shows material to have taken 100 per cent extension of joint width and the bond still intact.

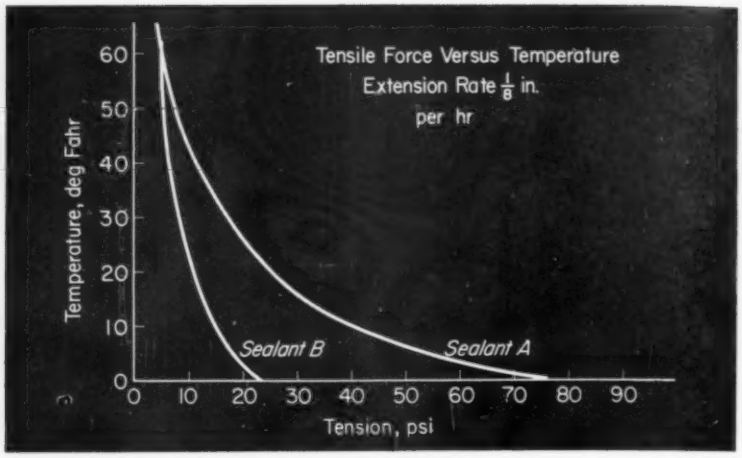


FIG. 9. Results of tests run to obtain data on strength versus temperature are shown in the graph above. Climatic conditions under which a given sealant may prove to be most effective can be forecast by means of tests of this type.

(Figure 4), so that there is no slippage or variation in speed with direct or reverse cycling. The speed reduction virtually precludes the driving motor from being overloaded by any sealant now envisioned. The first and second gear reduction units are enclosed and run encased in oil, thus ensuring long and trouble-free service.

Some of the tests already carried out on this machine are shown in the following illustrations:

In Figure 5 a mastic-type sealant has been extended to failure. As can be seen, the material failed in cohesion. The testing machine recorded the load at which this failure occurred. With this information it is possible to specify the maximum per cent extension permissible in a joint sealed with this type of material.

A typical adhesive failure of a mastic-type sealant is shown in Figure 6. Such failures usually occur as temperature is decreased. Since mastic-type sealants increase in hardness and cohesive strength at lower temperatures, the sealant will fail in bond at the point where cohesive strength exceeds adhesive strength. Knowing at what temperature this occurs, the designer can apply both adhesive and cohesive criteria in his design for the anticipated range of temperatures.

Elastomeric-type sealants exhibit characteristics which are quite different from those of mastic-type sealants. Particularly striking are the higher adhesive and cohesive strengths.

Illustrated in Figure 7 is a concrete-to-concrete joint which has been extended 650 per cent from its original ⅛ inch width. While the material is still bonded to the concrete surfaces and some of the material is still taking tension, internal failure has progressed to the point where the material would no longer serve as a sealant. Such internal failure is usually considered to result from air bubbles trapped in the sealant. These air bubbles are points of weakness from which internal failure develops. When such failure occurs, the surfaces of the sealant lose their characteristic parabolic shape.

Characteristic Curve

Figure 8 illustrates an elastomeric-type sealant which has been extended 100 per cent and is still intact. Note the characteristic parabolic curve conforming to the theoretical equation developed by Egon Tons. If any internal failure has taken place during this test the shape of the sealant would not conform to this curve.

Among the data needed on sealants are figures on temperature versus tension. The lowest temperature at which a sealant can successfully perform is determined by the relation of its adhesive to its cohesive strength at that temperature. Further, if the sealant is bonded to concrete or mortar, the performance of the joint itself may be determined by the tensile strength of the mortar at the sides of the joint. This mortar may have a tensile strength of 80 to 100 psi. If the force necessary to stretch the sealant exceeds this, the joint will fail in the concrete.

Figure 9 illustrates the results of tests showing strength versus temperature. Tests of this kind indicate climatic conditions under which a sealant may be most effective.

Notice that in the case of sealant A, with a small drop in temperature below 30°F., a much larger tensile force is required to stretch it. This particular sealant would not be suitable for low-temperature service since a small movement at low temperatures would impose a high adhesive stress. Sealant B, on the other hand, shows a relatively small change in tensile force with changes in temperature; consequently, it would be much more suitable for use in extremely low temperatures.

When investigating sealants it is highly desirable to have quantitative information with respect to load conditions rather than a mere knowledge of the ability of the material to extend at a given temperature. The information thus gained will enable the designer to predict the performance of a joint system under actual field conditions.

The tests described herein are illustrative of some of the uses to which the machine may be put. As we delve deeper into the mechanics of sealant materials, we are certain that more test programs will be devised. With the advent of new and refined joint sealing materials, particularly the epoxy resins, the horizons of joint design have been greatly enlarged. To avail ourselves of the better designed structures now possible, it is necessary to learn more and more about the physical properties of sealants.

A Review

Resin-Based Adhesives

Though they now account for only 30 per cent of the market, the possibilities afforded by the resin-based adhesives give them all but unlimited growth potential

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Resin-based adhesives fall generally into three areas of classification. First, there are thermoplastic materials that become plastic and flow under the influence of thermal energy derived from heat or pressure. In the second area are thermosetting materials which set or harden under the action of thermal energy from heat or pressure. In the final area of classification are mixtures or "alloys" of thermoplastic and thermosetting materials.

Commonly Used Resins

The most common thermoplastic resins used in adhesives include the *vinyl resins*, the *cellulosic resins* and *acrylic resins*—with vinyls taking by far the lion's share of the market. Contrasted with thermosetting resins, the thermoplastic materials are generally lower priced. They are usually marketed in solutions or dispersions or as water emulsions, and are used in processes that may either involve contact bonding or the use of heat and pressure. In contact bonding, the solvent evaporates and the materials to be bonded adhere when placed upon each other. The use of heat or pressure generally involves a closer bond, or insures complete contact over the whole area which is to be bonded.

Thermoplastic resins provide a good, flexible bond and are used primarily to unite plastics, wood, paper and leather. Because of their nature, however, these materials are seldom used for bonds that must exist in temperature environments exceeding 170° to 200°F., lest resin flow occur and the bond be broken. In addition, because thermoplastic materials generally have poor creep strength properties, and may flow under the internal forces created by tension or compression, they are used in unstressed or low-stressed joints.

The thermosetting resins used for adhesives include *phenolic* and *urea* resins, which taken together make up over 75 per cent of the resinous adhesive materials market, as well as melamine, alkyd, urethane and epoxy resins. These resins are generally priced somewhat higher than thermoplastic materials. They are sold and used either in solution form or as powders.

Because they cure or react under the influence of thermal energy, these materials are usually used in processes that involve the application of heat and pressure. Such heat and pressure is also normally required to remove any solvent, as well as to evaporate the condensation products as the resins themselves interact and cure.

Since these resins do not flow under heat, but actually cure, the temperature limit to which they can operate is normally higher than the thermoplastics, about 300° to 400°F. Beyond that, they generally decompose and burn.

About the Author . . .

JAMES J. MAHER is a member of the Sales Development Dept., Plastics Div., Reichhold Chemicals, Inc. He received his bachelor's degree in chemical engineering from Villanova University and has attended the Harvard Graduate School of Business Administration. Mr. Maher co-authored "Epoxy Resins: Market Survey and Users's Reference," for which he interviewed 100 companies throughout the country.

Thermosetting resins are used as bonding materials for metals and woods such as plywood, and in almost any joint that is subject to stress. The high creep strength properties of these materials has made them naturals in many structural adhesive applications. However, they tend to be more brittle than thermoplastic materials, and offer a lower impact strength, or peel strength. To improve these properties, thermosetting resins must be modified in certain ways. Let us examine some of the possibilities.

Mixing and Modifying

One of these modifications is to combine, "alloy" or mix thermosetting materials with thermoplastic materials. For example, phenolic resins have been alloyed with polyvinyl butyral resins. Such a combination improves the impact strength of the phenolic, as well as increases the heat distortion temperature that would be available if the vinyl system alone were used.

In addition to alloying these two types of resinous adhesives, one or both of these might be mixed with other adhesives, such as natural or rubber-based adhesives. Phenolic-neoprene adhesives have been prepared with a high degree of flexibility and excellent adhesion.

It is this type of mixing, or formulating that the adhesives formulator does. Such formulating includes not only the addition of other adhesives, but of fillers, extenders and other materials to modify and improve various critical properties of an adhesive. It is in this skill, or technology, that the growth of adhesives has its strongest asset and hope for expansion in the future.

Sales of synthetic resins for adhesive purposes totaled over 400 million pounds on a dry basis, in 1959. This figure represents approximately one-third of the total sale of materials for adhesive use. The 400 million pounds may be broken down approximately as follows:

Phenolics	over 200,000,000 lbs.
Ureas and Melamines ..	about 120,000,000 lbs.
Vinyls	about 80,000,000 lbs.
Others	about 12,000,000 lbs.

This represents a dollar volume of some $120 million to $150 million.

The phenolic resins are used for plywood, for reinforced plastic laminates, for thermal insulation and for friction materials and abrasives. The urea and melamine resins are sold primarily to bond plywood, and for reinforced plastic laminates. The vinyl resins are used in packaging, particularly for foods, as well as for paper containers, laminates of paper and metal foil, in shoes and on some furniture.

Estimates of growth over the next five to six years presume increased interest in use on the part of the consumer in both standard and structural applications where the resin-based adhesives excel. In addition, the exploitation of new materials such as the epoxy resins is taken into account. These estimates vary from an average growth of 14 per cent per year over the next five years to approximately 22 per cent per year growth.

The epoxy resins at present represent only a small amount in the total picture of resin uses in the adhesive industry. A recent survey by a group of students from Harvard Graduate School of Business Administration indicates that between two and three million pounds of epoxies were used in adhesives for 1959. This usage, however, is expected to increase, based primarily on the unique properties of the epoxy resins.

The epoxy resins are, of course, thermosetting resins, yielding upon cure hard, infusible products that will not soften upon the application of heat, and that are relatively insoluble. They are a two-part system —the resin and a hardener—and may be cured either at room temperature or by baking. This convenience of room temperature cure gives them a flexibility found only in a few other resins.

No Condensation Products

In addition to curing at room temperature, the resins cure with no products of condensation. This results in elimination of the necessity to use heat to drive off condensation products. An extremely low shrinkage occurs in the curing resin, partly for the same reason. Epoxies have good thermal properties, and are resistant to solvents and chemicals, especially alkalies.

Because of its peculiar chemical structure, the resin exhibits an extremely tenacious bond with most surfaces, and has a tremendous amount of internal cohesion. Its adhesion is due to the large number of polar or electromagnetic groups contained in the molecule. Others believe the adhesion is due to the actual opening of the epoxy ring and its subsequent bonding to the surface of the adherant itself.

In addition to these preceding unique features, the epoxy resins have a high degree of formulability that is, they can be mixed, or alloyed, with a number of other materials including phenolics, ureas, melamines, furanes, polyesters, vinyls, polyurethanes, and silicones. They may also be pigmented, be highly filled with a number of inert substances to reduce their cost, or to add flexibility; they are adaptable to a wide range of hardeners for control of curing times and conditions.

Marketing Problems

"With all these properties," you ask, "why are they selling only one-half of one percent of the market?" The problem here has no simple answer, but involves a number of considerations. In the first place, the epoxy resins are relatively new, and education concerning them is slow to catch on. A second reason is that initially the various hardener systems used to effect room temperature cures were found to be toxic; this toxicity has largely been minimized, but their handling characteristics at the early stages is unaffectionately remembered.

An equally important factor is their relatively high cost, which is nearly triple that of the vinyls, phenolics and ureas. For this reason, the epoxy resin content of most formulations has been kept down to a bare minimum. In addition to cost, however, the resin itself displays poor peel strength and ordinarily has to be modified for many applications involving high peel cycling. There are no doubt other reasons for the slow growth of epoxies in the adhesive field, but these are the foremost ones.

The excellent adhesive properties of the epoxy resins, together with their unique handling properties, are considered by many to be the factors that will help produce stronger interest in resin-based adhesives, and spur new growth.

They have already produced a new interest in structural applications, particularly in honeycomb bonding of airframes, and in bonding the skins of curtain walls to cores. In addition, epoxies are sparking a new growth in floor patching and resurfacing materials for alkali resistance, for wear resistance or for non-skid safety properties.

Continued growth, however, will not come of itself. It is predicated on two factors, the first, an enlightened and aware manufacturing community, and second, a highly capable adhesive industry with a strong motivation to produce, based on customer interest.

The need for the awareness on the part of the business community, and for a strongly scientific-based adhesive manufacturer's community is emphasized by recent advertisements which promote new adhesive materials as "miraculous." In these advertisements, the impression is given that miracle materials are easily prepared, easily used, and dirt-cheap.

These are the concepts that the adhesive formulator dreads. They neglect the fact that adhesive technology is a science and an art. There is no simple cure for most adhesive problems. The literature is filled with unsolved adhesive problems.

This may be appreciated when one thinks of all the materials, for example, that we have discussed under the classification of resinous adhesives. The thermoplastic resins, the vinyls, the acrylics, the cellulosics; the thermosetting materials, the phenolics, the ureas, the alkyds, the epoxies and the urethanes.

Need More Research

When you think of combining any of a number of these together with fillers, pigments in order to conform to required production needs and process variables, as well as environmental conditions such as temperature and humidity, we can appreciate the need for a more mature view toward adhesives and their technology. The increased use of new materials like epoxy resins will further complicate the picture.

We see, therefore, that the resin-based adhesives are an important factor in the growth of adhesives, in that these afford an open area for discovery and exploitation. This is not to minimize the importance of other materials for adhesives (which as noted above comprise about 70 per cent of the market), but is rather to emphasize the unlimited areas for discovery in synthetic chemicals.

We are, in addition, in an era of great interest in synthetic materials. It will be through the efforts of an enlightened group of men both at the adhesive manufacturing level, and at the consumer level that the growth of adhesives, in general, and the growth of resin-based adhesives, in particular, will continue.

Resin-Based Adhesives Find Many Applications . . .

in Tubular Magnets

in Aluminum Mold Rings

in Honeycomb Constructions

Photos courtesy of Research Sales, Inc.

Glycerol in Flexible Animal Glues

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Though not as glamorous as the synthetics, animal glue formulations combine ease of preparation with a highly complex protein structure that has yet to be duplicated

Despite the apparent magic of the word "synthetic" and its almost hypnotic effect on many buyers, the annual U.S. consumption of plasticized animal glue and gelatin compositions is at a higher level today than in any year prior to World War II.

Glues of animal origin have a usage history dating back more than 3000 years, but the flexible glue compositions of today are of much more recent origin. These plasticized and otherwise modified animal glue and gelatin products only began to realize their potentialities when certain fundamentals about their technical nature were developed. Clarified by progress in protein and colloid chemistry, and aided by the development of standardized testing methods, these discoveries have resulted in man-made glue and gelatin compositions with a great diversity of uses.

Flexible glues are basically combinations of animal glue, glycerol and water, characterized by the deposition of a glue film which "sets" rapidly and remains more or less flexible for an appreciable period of time. These glue or gelatin compositions may also be cast in molds to provide a tough, resilient, rubber-like or rigid solid, or may be utilized in other ways for a variety of purposes. Many kinds of modifying agents may be added to such compositions so as to alter them physically or chemically, to satisfy the multitude of different ideas on how the basic properties can best be used.

Flexible glue compositions combine the simplicity of easy preparation with the complex structure of a protein that nature has built but man has not yet duplicated. Authorities report that animal glue (or gelatin) contains more than 14 different amino acids. Derived from collagen by hydrolysis under a variety of pH and temperature conditions devised by man through centuries of experimentation, animal glues belong to the group of simple proteins, with molecular weights ranging from 40,000 upwards.

Structural Simplicity

In the midst of today's preoccupation with synthetic high polymers, many people lose sight of the fact that simplicity of structure, as exemplified by the "repeating units" of man-made polymers, carries with it consequent limitations in versatility of properties. The complex structure of animal glues and gelatins gives the application research man and the ultimate user a magnificent base, or building block, for a variety of compositions of proven value and of future potential.

Animal glue solutions set quickly to a jelly-like state on cooling from the liquid state; the jelly may be reversed by the application of heat, or made irreversible by appropriate chemical treatment. The films deposited from aqueous solutions are continuous, non-crystallizing, and of great strength and elasticity. All that is needed to prepare the animal glues and gelatins of commerce for practical industrial usage is some water, temperatures in the neighborhood of 140°F. and simple methods of adding other desired ingredients.

Animal glue solutions are compatible with modifying additives such as plasticizers, oils, fats, waxes, latices, and various emulsions of such materials. Under certain conditions other adhesive materials, inert solids, and even reactive chemicals may also be used in conjunction with animal glue compositions. Films may be rendered highly moisture-resistant by treatment with tanning and insolubilizing agents. Solid castings may be formulated as remeltable or non-remeltable and with a tough resiliency difficult to approach with natural or synthetic rubbers.

Glycerol's chief value in a glue composition is that it acts as a plasticizer. When glue or gelatin is mixed with or dissolved in glycerol, the mass is rendered permanently plastic, and remains so even when the water content of the mix is low. Glycerol changes the glue composition so that it does not dry, on loss of water, to a hard and often brittle material but remains flexible and strong.

This modifying effect of glycerol is due in large degree to its hygro-

scopic or moisture-retaining action which minimizes the effects of fluctuations in water content of the composition. Other so-called softeners usually behave in much the same way, though the sulfonated oils that were first used with glues as early as 1810 apparently exert more of an internal lubricating action than hygroscopic effects.

The fact that animal glues are used as a basic composition of matter, in addition to their more common use as an adhesive and size, accounts for much of the attention given to modifying additives. For many purposes, the tough, resilient, jelly structure of a glycerol-plasticized glue composition is effectively used; in other applications the non-crystallizing property of a tough, rigid glue structure is paramount.

The glue concentration may run from as low as 5 to 50 per cent or even higher, and the plasticizer content from a few per cent up to perhaps four times the weight of glue or gelatin in the composition. Inert fillers such as titanium oxide, perfumes, preservatives and other modifiers dictated by the intended end-use may also be incorporated.

Dried films deposited from simple mixtures of glue or gelatin and water are strong, but usually become brittle with age. To obtain a flexible or plastic composition or film, exploiting the inherent toughness of animal glue, it is necessary to employ a permanent plasticizing agent. The behavior of glycerol-plasticized glue and gelatin compositions depends on the properties of the components (glue, glycerol, tanning agents, penetrants, fillers, etc.) and on the way in which they are combined with water and with one another in the final composition.

Flexibility depends not only on the glue to glycerol ratio but also on the jelly strength and viscosity of the glue itself. The higher jelly strength and higher viscosity technical gelatins and hide glues are inherently stronger and will permit the use of larger amounts of plasticizer and other modifiers without losing strength as rapidly as lower strength, lower viscosity glues.

General Purpose Adhesives

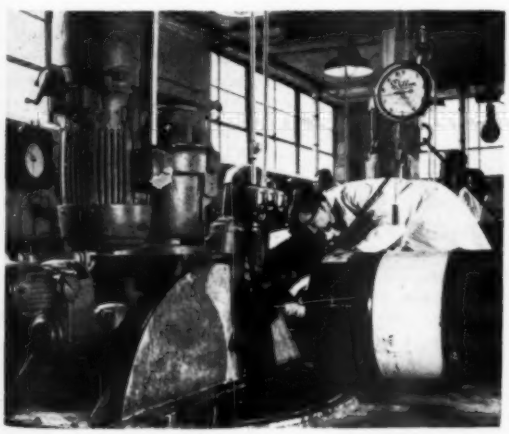
Animal glues are widely used as general purpose adhesives, especially where a strong, durable, tacky, fast-setting adhesive for hydrophilic (water-loving) surfaces is desired. Almost invariably a warm aqueous solution of animal glue is employed, thus permitting the user to obtain practically any desired speed or slowness of set. Working solutions remain liquid as long as heat is applied. They "set" to a gel state as soon as they have lost their heat, so that it is possible to make them grip and hold within seconds after their application. Major users of large tonnages for adhesive purposes include the abrasives industry, producers of paper containers, the woodworking industries, paper converters, bookbinders, etc.

Tenacity and continuity of films deposited from glue and gelatin compositions makes such products important in the sizing of textile yarns, in beater and tub sizing of paper, and in the production of gaskets, calcimines, wall sizes, window shades, hats, reed furniture, containers and barrels, etc. Greaseproof coatings that even resist penetration by mustard gas illustrate the excellent continuity of a film that can be laid down by high speed coating machines.

Related and almost identical compositions, are used in the manufacture of a variety of items such as printers rollers, graining rollers, graining-belts, hectograph and duplicating compositions, cork compositions, gelatin capsules, doll heads, molds for plaster casting and sand blast stencils.

Many of these adhesives, sizes and specialty items were originally developed by artistans in the various industries, and subsequently improved or modified by chemists and technicians to meet specific needs of expanding mechanical operations. But it almost seems as though today's technical men have become so involved with "synthetics" that application research leading to new uses of animal glue compositions is being neglected. It therefore seems worth while to review briefly some of the

Production Phases in the Preparation of Glues



Components used in the preparation of flexible animal glue are shown being poured into a mixing unit at the Ohio plant of Armour Alliance Industries.

In another phase of adhesive production at Armour Alliance, liquid glue is poured into drying molds. Animal glues have highly complicated protein structures.

Table I—Effect of Glue-to-Softener Ratio on Application Viscosity and Gel Strength

	Formula 1	*Formula 2*	*Formula 3*
400 gram glue	30%	—	20%
180 gram glue	—	30%	—
Glycerol	45%	45%	20%
Water	25%	25%	60%
Viscosity, cp. at 75°C.	2545	1020	73
Gel strength at 25°C.	1353	808	313

typical applications, formulations and reasons leading to successful applications and formulations.

In formulating flexible glue compositions a number of factors are involved:

(1) Types and grades of glue (including edible and technical gelatins).

(2) Type of softener.

(3) Thickness of film or composition desired.

(4) Character of base on which the adhesive or size is to be applied.

(5) Methods of application or usage.

(6) Inert additives that may be required.

(7) Possible need for additives such as preservatives, perfumes or dyes.

(8) Water content at initial and final stages of formulation and usage.

There are other factors that apply to specialty end-uses or objectives. For example, flexible gelatin capsules for pharmaceutical purposes are governed by need for lack of toxicity in all ingredients. Some compositions may need the addition or application of aldehydes to promote water resistance of the film or composition.

The choice of glue and softener is fundamental. In choosing the grade of glue or gelatin, its cost, availability and water-holding power are primary values. Technical gelatins and high grade glues are more flexible and hold more water than low grade glues. The more water that can be tolerated, the thinner the film that can be laid. Hence the higher grade glues give faster set, less penetration, with thinner films and correspondingly greater coverage capacity.

A number of softeners have been tried and used, but glycerol seems to be preferred by most users for its balanced combination of desirable properties. When the glue is mixed with, or dissolved in, an appreciable amount of glycerol, the mass is rendered permanently plastic, and remains so even when the water is evaporated. Glycerol-plasticized glue films remain flexible and yet retain their adhesive strength.

The ratio of glue to glycerol is important not only in governing the flexibility of the resulting composition but also in changing the speed of setting, the amount of water that needs to be added, etc. Any increase in the percentage of glycerol will, in general, decrease speed of setting but improve flexibility. Decreasing the percentage of glycerol causes these effects to be reversed. To illustrate the point, here are some typical formulas developed by the Government Printing Office for use in the bindery

(1) For use on gathering, stitching, and covering machines:

Glue*	36.30 per cent
Glycerol	16.60 per cent
Water	46.80 per cent
Beta naphthol	.15 per cent
Terpineol	.15 per cent

(2) Tablet composition:

Glue	26.50 per cent
Glycerol	26.50 per cent
Water	46.70 per cent
Beta naphthol	.15 per cent
Terpineol	.15 per cent

*400-gram gel strength

(3) For cabinet-making work:

Glue	41.50 per cent
Glycerol	2.80 per cent
Water	55.40 per cent
Beta naphthol	.15 per cent
Terpineol	.15 per cent

Formula 1 grabs the paper faster, sets up faster, than Formula 2, but Formula 2 produces an adhesive film of much greater flexibility. In Formula 3 no real flexibility is desired, but the small percentage of glycerol keeps the adhesive from drying out completely to a hard, brittle film on aging.

In the preparation of flexible glues the dry glue is soaked in cold water for an hour or two until soft, and is then melted in a jacketed kettle at 145°F. The amount of water to be added to the dry glue will vary with the grade of glue and the final fluidity required, and is determined by trial. The desired weight of glycerol is then added to the melted glue solution and uniformly dispersed. The adhesive may then be used directly on the machine.

Change in Water

The effect of changes in water content is largely reflected in changes in viscosity (fluidity) and gel strength, prior to application. Changes in the grade of glue employed and in the ratio of glue to softener also change the application viscosity and gel strength, as is shown in Table I.

It is the unique property of gelling when a solution is cooled that makes animal glue so well suited for many industrial uses as an adhesive. The time of "set" may be as short as one minute or less, or as long as five or even ten minutes, depending on the formulation and conditions of application. In other words, it has a wide working range which is adjustable to practically any set of conditions. Its "tackiness" is immediately apparent on cooling, and its films are contin-

Table II—The Range of Glue and Glycerol Compositions

	Formula 1	*Formula 2*	*Formula 3*
Hide Glue (Delaney #8911)	41.2%	30.0%	23.1%
Glycerol	41.2%	53.3%	63.7%
Water	17.6%	16.7%	13.2%
Viscosity, cp. at 75°C.	75,000	9250	2480
Tensile strength, lbs./in.² at 25°C.	161	118	65
Gel Strength, grams at 40°C.	530	297	171
Gel Strength, grams at 25°C.	2945	1863	975

uous. Its polar groups enable it to wet many surfaces and its long chain molecule provides a tough joint.

For sizing purposes, animal glues are prepared in a range of 2 to 12 per cent dry glue, usually with the addition of such modifiers as glycerol where a size film possessing elasticity, resiliency and toughness is desired. In textile sizing, glycerol may compete with sulfonated oils whose main function is to impart lubricity. In paper manufacture, where such compositions may be used as primary adhesives, auxiliary binding agents, coatings, etc., it is often desirable to treat the sized paper with tanning agents to provide surfaces that will withstand "wet rubbing."

In industrial compositions, where glue or gelatin serves as a major constituent, the ratio of softener to glue is usually in the range of 1:1 to 3:1. The water content may vary from perhaps 15 to 80 per cent, depending on whether the composition is being cast in a definite size and shape, as in printers rollers, or being used as a saturating solution, as in gaskets. Practically all standard grades of glue and gelatin have been used in making up such mixtures.

Used for Sealing

Animal glue-impregnated gaskets, made from fibers, paper pulp or asbestos, are widely used as seals for gases, air, gasoline, water, and oils. The finished dried gasket stock has approximately doubled its original weight as a result of picking up the saturating solution. By keeping the glycerol to glue ratio in the range of 2:1 to 3:1, the resulting gasket has enough flexibility to serve as a compressible membrane that will prevent leakage where two flanges or surfaces are joined together.

In the preparation of cork compositions to be used as gaskets, bottle-cap inserts, and related manufactured products demanding toughness, resiliency and permanence, glycerol-plasticized animal glues are still preferred as the principal binder and composition base. As with fiber-base gaskets, a "tanning" material, usually paraformaldehyde or hexamethylene tetramine, is incorporated to secure desired moisture resistance. The base formula that follows is indicative of many such in general use

Cork granules	100 pounds
Glue (380 gram)	10-13 pounds
Glycerol	22 pounds
Water	18 pounds

About the Author . . .

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Diverse products as typified by printers' rollers and the gelatin capsules used to hold liquid medicaments are based almost exclusively on mixtures of glue or gelatin with glycerol and water. These products are normally cast in metal forms or molds which are lightly coated with an oil dressing to prevent sticking of the filled composition to the walls of the mold or "gun." Allied with printers' rollers are graining-rollers and graining-belts which are employed for the transferring of designs to metal surfaces.

Gelatin capsules are sold as hard or soft capsules, while printers' rollers are formulated so as to be softer for winter usage and harder for summer usage in the printing plant. The higher test glues or technical gelatins are used in the non-edible industrial products, while edible gelatins are employed for pharmaceutical and veterinary products. The formulations in Table II illustrate the range of such compositions.

Viscosity Increase

Despite the slight decrease in water content, while the glycerol content increases at the expense of the glue content, there is a progressive decrease in viscosity of the hot solution, and in gel strength of the composition. The composition with equal parts glue and glycerol is the hardest of the three, of course, and is somewhat typical of the rollers that are used in hot, humid atmospheres. When the air is drier and cooler, as in winter, the higher softener content insures the resiliency and elasticity despite conditions that would otherwise cause embrittling action.

Where non-meltable roller compositions are desired, small amounts of formalin or a formaldehyde-yielding chemical can be added just prior to the casting of the roller; dyes or pigments can be added to impart color. Related applications are also found in hectograph compositions, in duplicating-rolls, in sand-blasting stencils, and in trade novelties.

Meet Special Needs

Animal glue and gelatin manufacturers, as well as artistans in a wide variety of fields, have devised numerous formulations and compositions to meet special needs and conditions. But it is hardly a coincidence that the development of information and techniques that offer the possibilities of rapid expansion in plasticized-glue usage and technology coincides with the development of synthetic polymers. It is more interesting to search for new fruits in a new world than to try to grow them in one's own back yard.

However, the animal glue and gelatin natural polymers do possess a chemical complexity that makes them more than a rival for many of the newer, yet actually much simpler, synthetic high polymers. In addition, the ready availability of natural and petroleum-derived glycerol, and of ordinary water, gives the chemist and technician a modifier and solvent for these complex natural polymers. Why, then, neglect the glues and gelatins, leaving the development of their growth potential to those who develop secret formulas and arts of application in traditional fields?

There is no particular magic in the word "synthetic." We should not allow the glamour of these resins to hypnotize us.

Auto Fleet Leasing in the Adhesives Industry

More than 2000 automobiles annually are leased by adhesives manufacturers who have found that the system preserves their working capital and eliminates many supervision headaches

By A. J. SCHOEN
President, Wheels, Inc.
Chicago 45, Ill.

How much auto fleet leasing is done in the adhesives industry?

At the end of July, 1959, there were 240,000 cars in leased auto fleets used by all industry. Of that number, about 2000 are in leased auto fleets used by adhesives manufacturers for their salesmen. Another 2100 cars in the industry are company-owned, and still another 4600 are owned by individual adhesives salesmen and used for company business.

In the adhesives field, there are two major reasons why such companies as American Marietta, B. F. Goodrich, The Borden Co., Commercial Solvents Corp., and others lease their cars. The first big reason is the desire to preserve liquid working capital for use in the business.

The typical producer of adhesives has a ratio of current assets to current debt of about 2.5-to-1. This ratio is adequate to run a business; normally a ratio of 2-to-1 is regarded as minimal. Moreover, the typical adhesives producer has fixed assets tying up 50 per cent of his net worth, and inventory equal to about 66 per cent of his working capital. Holding on to liquid cash, therefore, is a "must" for most adhesives manufacturers. Leasing rather than buying company car fleets is one way in which liquid cash can be retained. Using salesman-owned cars is another way.

Second, many adhesives producers have found that a leased fleet presents fewer headaches in supervision, operation and sale of used cars, than does a company fleet. In addition, depending on mileage and allowances, a leased fleet is most often cheaper to operate and more efficient than salesman-owned cars.

What types of autos are leased?

All types. Most leased auto fleets are low-priced cars for salesmen, higher-priced for executives. Some companies lease station wagons. There is no restriction as to make, model or optional equipment.

Why has auto fleet leasing grown so rapidly?

Auto fleet leasing came into the picture before World War II. Large adhesives producers found that they could use their own capital to better advantage in production, so instead of buying their auto fleets, they leased them. After the war, medium-sized and smaller companies found the same advantage to be true. What precisely is this advantage?

Net profits on net working capital in the adhesives field today average around 45 per cent *before taxes*. If a producer buys an auto fleet (say, 50 cars) costing $100,000, he must take this money out of his current operations. By so doing, the company would be sacrificing $45,000 net profit before taxes if the capital were invested in an auto fleet. In other words, the average "cost" of purchasing a fleet with an adhesives manufacturer's own capital would be 45 per cent of the amount invested in autos per year.

On a $100,000 fleet, that "cost" would be $45,000 the first year, less (because of depreciation) the second year. These sums are part of the true cost of company-owned fleet operation.

In short, freezing of working capital in additional fixed assets (such as an auto fleet) when *use* of these fixed assets is available through leasing, is a questionable procedure. After all, profits are made by *use* of assets, not their ownership. This applies not only to autos, but to buildings, land, postage meters, production equipment, etc. This realization, since World War II, goes far to explain the growth of leasing.

If you compare earnings of two adhesives companies of the same size and annual sales volume—one company using a leased fleet of 50 cars on two-year lease, the other using a company-owned fleet of 50 cars—the company with a leased fleet would be about $90,000 ahead of the second company using a company-owned fleet. This $90,000 would be cumulative *after-tax* net profit at the end of two years.

An objective analysis of the different methods of fleet acquisition has been developed by the Foundation

tor Management Research. It is entitled "Advantages and Disadvantages of Auto Fleet Leasing: A Comparison of Company Ownership, Salesman Ownership, and Leasing." Single free copies may be obtained by writing to the Foundation for Management Research at 121 West Adams Street, Chicago 3, Ill.

How does auto fleet leasing work?

There are two basic types of auto fleet leasing plans: the Finance (Equipment Trust) Lease and the Maintenance (Fixed-Cost) Lease.

The Finance Lease: In this plan, Wheels, Inc., for example, provides the auto fleet at special fleet prices, delivers them to the salesmen in their home territories, and sells the fleet at the end of the lease period, which is normally two years.

For these services, the leasing company charges a monthly leasing fee. To this is added a monthly payment (2 per cent of original cost) covering depreciation. All costs of maintenance are borne by the user. In short, the Finance Lease gives the user a brand-new fleet of cars, and handles the sale of the used cars. Everything else is provided by the user of the automobiles.

However, one of the intangible but strong benefits of this plan is the guidance of the leasing company as to the best type of cars to use for a particular company's business, and the best time of the year to dispose of the used cars. Where the leasing company is a large national concern with years of experience, it can dispose of used fleets in different used car markets throughout the country. At any given day, prices for a given model may be higher in one city than another. A national leasing company keeps abreast of such price situations in order to get the best prices for its clients' used car fleets.

The Maintenance Lease: In this plan, the leasing company not only provides the new fleet, but takes over the whole expense of fleet operations, except for daily gas and oil costs. This includes buying the fleet, delivering it to salesmen in their home territories, all repairs and maintenance work, insurance, licenses, taxes, tires, and selling the fleet. The leasing company also bears all risks of depreciation.

For this whole package the leasing company charges a flat monthly fee. The user has a fixed cost and knows exactly what his fleet operating costs will be. The user is out of the automobile business.

What are the advantages of auto fleet leasing?

In addition to conserving a company's working capital, auto fleet leasing offers these advantages.

(A) Leasing an auto fleet is a form of financing which does not affect a company's ability to borrow from its normal sources. If a company borrowed to buy an auto fleet, such borrowing would appear as a liability, and affect the company's remaining credit. A leased fleet, however, is not a liability, nor does it affect a company's borrowing power any more than does annual rent for a building.

(B) Leasing frees company executives from supervising an auto fleet and enables them to devote their full time to the company's main business.

> ***". . . since the end of World War II . . . only 25 per cent of the autos used by industry are in company-owned fleets."***

(C) In most situations a leased auto fleet is more economical than other forms of operation.

(D) Companies using a Maintenance Lease can budget transportation costs for 12 or 24 months in advance.

(E) A leased car is often an important fringe benefit to offer a company's salesmen or to attract good new salesmen. It eliminates a morale problem where salesmen object to using their own cars on company business.

(F) Through leasing, a company's salesmen have latest model cars, well-maintained, which enhance the company's prestige and give its sales force the best transportation available.

(G) Autos are delivered directly to salesmen in their home territories and picked up from them at trade-in-time. Salesmen do not lose days trading in their cars.

When is leasing NOT advantageous to a company?

(A) A company which has more short-term and long-term capital than it can profitably use in its direct business operations, will not find leasing advantageous. After all, why pay a leasing company for use of capital, if the user has spare capital of his own? Occasionally, even such a company will go in for leasing merely because leasing relieves company executives of the administrative burdens of buying and selling cars, and possibly fleet management. The company may find that by leasing, lower prices on new cars and higher prices on used cars may be secured.

(B) A company which pays its salesmen by commission only—without direct reimbursement for the use of their cars—will not find leasing advantageous. However, it is a mistake to think that since the salesman pays for the car out of his pocket, that the company has none of the burden. True, the company does not have to lay out capital to buy a salesman's car, but the company does have to pay a commission broad enough to cover the cost of car operation.

(C) Companies whose salesmen average 1000 miles per month or less in auto travel, primarily in cities, find it advantageous to reimburse their salesmen on a cents-per-mile basis—but only if the rate is under 10 cents, and the company is indifferent to what the salesmen's cars look like. Where this latter is unimportant and the total cost to the company is under 10¢ per mile, such companies should continue to use salesmen's cars. The Foundation report, mentioned earlier, has some interesting tables on this.

How does leasing compare with company ownership of auto fleets?

Company-owned auto fleets have been declining since the end of World War II. On the average, only 25 per cent of autos used by industry are in company-owned fleets. In terms of cost, data for most company-owned fleets show an *apparent* lower cost (per mile) than for leased fleets. This is misleading, since companies conveniently overlook the cost of their own capital invested in their own fleets. The cost of capital *is* included in charges made by a leasing company.

How does leasing compare with salesman-ownership of auto fleets?

Many of the companies using salesman-owned fleets are smaller companies. Salesman-ownership of cars eliminates any company investment in a fleet, which is similar to the advantage offered by leasing.

Most of these salesmen are reimbursed for the use of their cars on a cents-per-mile basis. In the adhesives manufacturing field the national average for such payments is 9.13 cents per mile and salesmen average 19,000 miles per year. Except for low-mileage fleets, leasing is normally less expensive.

While saving of company capital is important, salesman-owned cars have some serious drawbacks. For one thing, if company mileage payment is 7¢ a mile, a salesman-owned car driven more than 23,000 miles a year is more expensive to operate than using a leased car. At 8¢ a mile, a salesman's car driven over 18,000 miles a year is uneconomical for any company; a leased car is cheaper. At 9¢ a mile, anything over 17,000 miles is too expensive; leasing is cheaper.

What are recent trends in auto fleet leasing?

The most recent trend in auto fleet leasing is the Finance Lease, described earlier. This conserves a company's working capital while enabling the company to take advantage of any lower operating costs that may be peculiar to its fleet operation under its own fleet manager.

What is the length of auto lease terms?

Finance Lease terms are generally for two years or more, except where companies have extremely high mileage (50,000 miles per year, for example). The one-year lease is rapidly disappearing because of the high depreciation factor in the first 12 months of an auto's life.

How can I tell if my company should lease its auto fleet?

Each company must examine its own particular situation. If a company can use outside capital in the form of a leased auto fleet and keep its own capital working in the business at a better return, then it pays to lease. To determine this, companies should examine their own returns on net working capital before making a decision. Similarly, if a company is using a salesman-owned fleet, it should examine whether or not this is more costly than leasing and whether salesmen's morale and transportation efficiency could be improved through leasing.

About the Author . . .

A. J. SCHOEN, president of Wheels, Inc., was co-founder of the company in 1939 with Z. S. Frank. He did his undergraduate work at the Universities of Wisconsin and Chicago, and his graduate work at John Marshall Law School.

Antarctic-bound ship gets

Frostproof Epoxy Coat

A new deck coating, based on epoxy resins, has added a modern touch to the "Vema," the 37-year-old, three-masted oceanographic schooner belonging to Columbia University's Lamont Geological Observatory.

The "Vema," now on her sixteenth expedition, is on her way to circumnavigate the Antarctic continent to gather scientific data which will contribute markedly to our knowledge of the earth. More specifically, Lamont scientists believe that an examination of cores which will be taken from the ocean bottom as near the ice as possible, will indicate changes of climate going back millions of years and show that the weather in that area at one time was much different than it is now.

Several important considerations governed the selection of an epoxy coating for the steel decks of the "Vema," according to V. R. Sinclair, retired Navy Captain and member of the Lamont staff. The prime requirement was for a material that would protect the steel deck from salt-water corrosion, sun, and the extreme temperature changes encountered in sailing from the sub-freezing temperatures of the Antarctic to the 130-degree temperature they are likely to encounter off Aden in the Red Sea.

A second important factor, Captain Sinclair noted, was the need for a safe, non-skid surface for the steel decks, since the "Vema's" size and the nature of her work in heavy seas make sure-footing a critical factor. The non-skid surface provided by the epoxy coatings will minimize the possibility of a recurrence of an incident several years ago when Dr. Maurice Ewing, director of the observatory, and three other members of the expedition were swept overboard in heavy seas.

Since the "Vema" would be away from its home berth for nine months, it was essential that they choose a coating that would go for long periods without maintenance since the relatively small staff (a crew of 18 and a scientific team of approximately 12 men) has too many duties to permit extensive maintenance operations at sea.

The epoxy coating applied to the "Vema" was manufactured and applied by the Burmar Chemical Corporation, of Brooklyn, New York, from Bakelite epoxy resins produced by the Union Carbide Plastics Company, Division of Union Carbide Corporation.

In the "Vema" coating application, Burmar used more than 600 gallons of the epoxy compound in coating the main deck, the deck-house roof, bridge, battery room and other storage rooms of the 202-foot vessel. In most cases the coating was troweled on to a thickness of 3/32 of an inch. A small amount of material was brush-coated to a ten-mil thickness.

NEWS of the ADHESIVES WORLD

Adhesives Testing Session Features Tappi Meeting

More than 200 paper technicians and production men attended a special Adhesives Testing Session featured on the program of the 45th annual meeting of the Technical Association of the Pulp and Paper Industry held at the Hotel Commodore, New York, N.Y., February 22-25.

Speakers at the session included P. B. Davidson, Mellon Institute, Pittsburgh, Penna.; William Neuss, Armour Alliance Industries, Alliance, Ohio; and J. J. Bikerman, Massachusetts Institute of Technology, Cambridge, Mass. The meeting was chaired by William W. Sederlund, National Starch & Chemical Co., Plainfield, N.J. Mr. Sederlund is also chairman of TAPPI's Testing of Adhesives Committee, under whose sponsorship the special session was presented.

Surface Tension

"A Measure of Surface Tension and Surface Film Elongation" was the title of Mr. Davidson's paper. He outlined a method whereby with the use of an Instron Tester it is possible to obtain not only a measure of surface tension but also a measure of force-ring displacement or surface-film elongation of animal glue dispersions. The latter property, he pointed out, was found to be influenced by protein disintergration products, zinc salts that were added as a preservative, and by defoaming agents. Mr. Davidson listed the conditions for the test method as they apply to the testing of animal glue dispersions. He also outlined a foaming test for such systems.

Mr. Neuss presented a paper entitled "The Correlation of Laboratory Tack Testing with the Machine Performance of Adhesives." The paper had been co-authored by F. N. Rosenblum, also of Armour Alliance Industries.

By means of a laboratory model T-A-C tester, Mr. Neuss explained, a series of carton-sealing adhesives were evaluated for strength of tack in the laboratory. Both resin and vegetable adhesives of varying solids contents and viscosities were studied. These adhesives were then run commercially on a Clayborne carton sealing machine and some correlation between laboratory evaluation and machine performance was observed.

In his talk on "The Theory of Adhesion," Mr. Bikerman emphasized the point that molecular forces across the interface between an adherend and an adhesive never determine the strength of an adhesive joint. If a joint seems to fail in adhesion, he noted, the presence of a weak boundary layer may be suspected. "An adhesive joint breaks," Mr. Bikerman stated, "when *local* stresses exceed *local* strength."

At the conclusion of the prepared talks, the meeting was thrown open to questions from the floor.

At a general session of the association's annual meeting, announcement was made of the re-election of James R. Lientz, vice-president, Union Bag-Camp Paper Co., Savannah, Ga., as president of TAPPI. Mr. Lientz will continue to serve in this capacity until February 1961. Also re-elected for another year was the TAPPI vice-president, Harold M. Annis, vice-president in charge of research, Oxford Paper Co., New York, N.Y.

Plan Adhesives Program for Gordon Conferences

Nine papers on adhesion are scheduled to be presented on August 29 to September 2 at New Hampton School, New Hampton, N.H., as part of the 1960 Gordon Research Conferences, which will be held from June 13 to September 2 concurrently at New Hampton School; Colby Junior College, New London, N.H.; and Kimball Union Academy, Meriden, N.H. Harold F. Wakefield will serve as chairman of the Adhesion Conference and Robert L. Patrick will be vice-chairman.

The five-day program for the Adhesion Conference is:

August 29, "The Science of Adhesive Joints," by J. J. Bikerman; "Degradation of Adhesive Joints Through Heat or Aging," by F. J. Reil; and "Mechanism of Failure," by G. R. Irwin.

August 30, "Adsorption of Adhesives on Surfaces," by F. R. Eirich and "Adhesion and the Chemical Nature of Surfaces," by W. T. M. Johnson.

August 31, "Investigations with Atomically Clean Surfaces," by H. E. Farnsworth and "Relation between Resin Composition, Physical Properties, and Bond Strength," by C. A. May and A. C. Nixon.

September 1, "Factors Which Affect Adhesion of Cellulose Fibers," by John W. Swanson and an open session on current problems in adhesion research, with John W. Rutzler serving as discussion leader.

September 2, "Science of Adhesion Through Ceramic and Inorganic Compounds," by D. V. Rosata.

Shell Moves Offices

Plastics and Resins Division, Shell Chemical Co., has moved its eastern district staff to new offices. The eastern district office, with Dave Neely serving as district manager, is now located at 42-76 Main St., Flushing 55, N.Y.

Increasing PVC Capacity

Borden Chemical Co., New York, N.Y., has announced that it will construct a polyvinyl chloride plant in Illiopolis, Ill., with a total capacity of 40 million pounds. Involving an investment of over $4 million, the new plant will be located adjacent to the company's existing manufacturing facilities in Illiopolis. A 20-acre tract of land already has been purchased and engineering for the project is nearing completion, the company states. The plant will produce the firm's full line of polyvinyl chloride and copolymer products, including those for the vinyl flooring industry, the record industry, solution coatings and extrusion grades, and specialty resins. Completed plant facilities will include raw material storage, polymerization reaction, blending, drying and compounding equipment. According to Borden, the new unit will allow it to offer fast customer service, help meet the needs of expanding Midwest markets, and also place important new capacity close to the strategic Mississippi River system.

Reichhold Buying Firm

The board of directors of Reichhold Chemicals, Inc., White Plains, N.Y., have approved the acquisition of the assets of Alsynite Co. of America, San Diego, Calif., for an undisclosed number of shares of Reichhold common stock. Included in the acquisition will be assets of Alsynite Co. of California; Alsynite Co. of Ohio; Alsynite Co. of New Jersey; Everlite Corp.; Plastikool Awning Corp.; Ray-O-Lite Corp. of America; and Chemiglas, Inc. The acquisition is subject to the approval of Alsynite stockholders. Alsynite is a major producer of reinforced plastic panels. Reichhold reports that it plans to broaden Alsynite's line and also expand its foreign operations.

Miracle Names Sheesley

Miracle Adhesives Corp., Bellmore, New York, has announced the appointment of J. E. Sheesley as architectural representative. The company reports that Mr. Sheesley, a veteran with over 35 years construction experience, will be available to architects, builders and engineers for consultation on construction-by-adhesion techniques. Mr. Sheesley previously had been manager of the Face Brick Division of Lehman Sewer Pipe Co.

3M Splitting Stock

A three-for-one split of its common stock has been recommended for stockholder approval by the board of directors of Minnesota Mining & Manufacturing Co., St. Paul, Minn. By unanimous vote, the board proposed enabling amendments to the certificate of incorporation of the Delaware corporation and placed the matter on the agenda of the annual stockholders meeting on May 10. Approval of the stock split requires a majority vote of the outstanding stock. The proposed stock split is the sixth in the 58-year history of the company. Most recent was a two-for-one split in May, 1956. A four-for-one split occurred in 1951. Two-for-one splits also occurred in 1945, 1922 and 1920. The new split will raise to 192 the number of shares resulting from each share held prior to 1920.

Metachem Resins Formed

A new organization, Metachem Resins Corp., Cranston, R.I., has been formed to serve industry with specialized chemical formulations in the epoxy, polyester and allied resins fields. The company reports that in order to serve the many varied needs and requirements of these fields, it has assembled a staff of engineering specialists, technicians and consultants whose function will be to work with customers in solving problems and who will also develop the specialized formulations required for specific applications. The new company also announced that Herbert L. Spivack has been named its president. Mr. Spivack previously had been the technical director and general manager of Isochem Resins Corp.

I don't want to rub it in, but remember how you *insisted* on ordering the cheapest adhesive available?

Forms Evaluation Center

The United States Department of Defense reports that the Army Ordnance Corps has established a Plastics Technical Evaluation Center at Picatinny Arsenal, Dover, N.J. The center, operated under the direction of the Office of Director of Defense Research and Engineering, will collect, evaluate, store and disseminate technical information on current development, engineering and application work in the field of plastics and reinforced plastics. In addition, the center will supplement already existing activities of the military departments by providing technical assistance and consulting services on problems involving the use of plastic materials to military contractors and suppliers. According to the department, the new center will also endeavor to stimulate advances in standardization of processes, products, testing methods, and materials in the field of plastics. It is reported that a close working relationship will be maintained between the center and the laboratories of the Army, Navy and Air Force.

Polymer to Expand

Polymer Industries, Inc., Springdale, Conn., has announced the completion of its new half-million dollar production and laboratory facilities at Springdale. The company also announced that construction has begun on a new polymerization plant and a new solvent-mixing plant, also in Springdale. Estimated cost of these new facilities is also $500,000. Dr. Frank C. Campins, president of Polymer, states that though the firm's reputation in the field of adhesives has been primarily achieved as a result of its laboratory developments, the company is now well organized for mass production to meet increasing demands by the varied industries it supplies.

Fuller Enlarging Plant

H. B. Fuller Co., St. Paul, Minn., has begun construction of a 7,000 square-foot addition to its plant in Linden, N.J., which will nearly double the plant size and capacity. Providing enlarged manufacturing facilities, the $75,000 addition will house a new adhesive mixer and a dry blender, and shipping, receiving and storage areas also will be located in the new area. Construction of the addition started in February and is expected to be completed by early summer, the company states.

Sales and Earnings Up

National Starch & Chemical Corp., New York, N.Y., reports record sales and earnings for the year ended December 31, 1959. The company's net sales totaled $52,768,725, compared with 1958 sales of $46,200,145. The 1959 net income after taxes amounted to $3,337,150, earning $1.67 per share of common stock, compared with $3,130,667, equal to $1.58 per share for the 1958 fiscal year. The $1.67 per share earnings is after payent of preferred dividends and the 1958 figure was computed after adjusting outstanding shares for a 2-for-1 stock split on May 9, 1959. Earnings in 1959 include a non-recurring credit of 12¢ per share arising from adjustment of excess accruals. Earnings in 1958 include a non-recurring credit amounting to 12¢ per share arising from a tax carry forward loss incurred by Granite Board, Inc., consolidated on November 28, 1958.

Develops Stycast Resin

A new fire retardant epoxy casting resin which may be cured at room temperature has been developed by Emerson & Cuming, Inc., Canton, Mass. According to the company, the material, designated Stycast 1231, has excellent adhesion to metals, plastics and ceramics. Due to its low thermal coefficient of expansion and high heat stability, large embedments can be made, the company reports. The resin is said to be stable over a temperature range of −100 to +350°F. Normally supplied in black, Stycast 1231 can be color coded to specification. Emerson & Cuming reports that thin sections of cured Stycast 1231 repeatedly introduced to a flame will, on each occasion, immediately extinguish itself.

USAF Tape System Report

A pressure-sensitive tape suspension system for supporting aircraft parts in shipping containers is the subject of a United States Air Force report. The tape system described in the report was tested and found adequate for supporting aircraft parts. The report also covers basic data on the tapes; methods of attaching the tapes to the container; test methods and instrumentation; and the relation between the weight of the item and the strength required for glass filament-reinforced tape. The report is available from the Office of Technical Services, BDSA, Department of Commerce, Washington 25, D.C.

William E. Kelly

Kelly Joins "Adhesives Age" Advisory Board

William Edward Kelly, manager of the Adhesives Department, Chemical Division, Goodyear Tire and Rubber Co., Akron, Ohio, has joined the Editorial Advisory Board of ADHESIVES AGE magazine. He succeeds John E. Warner, manof Goodyear's Chemical Division.
Division.

Mr. Kelly joined Goodyear in 1949 after receiving his M.S. degree from Lehigh University. He was recently appointed manager of the company's newly formed Adhesives Department.

Foresees Epoxy Gains

Union Carbide Plastics Co., New York, N.Y., in announcing its latest epoxy achievement, a 40,000 pound capacity cargo carrier, states that it will soon be possible to order epoxy building materials directly from a catalog in the same manner as roof tiles, storm windows, paint, etc. According to the company, the most promising prospect for epoxy structural panels lies in the field of bulk materials handling. Large, strong, light containers that resist attack by many chemicals, salt water and cleaning detergents will advance materials handling techniques, the company states. The new UC cargo carrier, constructed of epoxy glass fiber, is reported to be capable of carrying its payload by rail, motor or ship. It measures 24 feet long, 8 feet wide and 8 feet high. Weighing 2,800 pounds, the epoxy cargo carrier is said to be 25 per cent lighter than a comparable aluminum container, the company states.

Staley Names Two

A. E. Staley Manufacturing Co., Decatur, Ill., has announced that Dr. David P. Langlois has been named director of administrative services for market development, and Dr. M. J. Thomas has been appointed director of chemical market development. Dr. Langlois received his bachelor's and master's degrees from the University of Utah and his doctorate from Pennsylvania State College. He joined Staley in 1932 as a senior research chemist. He served as a group leader in research and as a technical information scientist in the Research Division. Dr. Thomas is a graduate of Mississippi State College and received his doctorate from Vanderbilt University. He joined Staley in 1942 as a research chemist, moved to the Market Development Division as an assistant in 1948, and was named assistant manager of this division in 1953.

Laminates For Missiles

A research program on an entire new group of laminated plastics for missile application has been launched by Taylor Fibre Co., Norristown, Penna. The company reports that the program is designed to develop improved materials for use in nose cones, throat nozzles and other missile parts. According to Taylor, laminates now in use for missiles were developed primarily for electrical applications. Its new program is aimed at developing laminates specifically for missiles. The firm is preparing a variety of web and resin laminates for testing. The web materials to be tested include paper, asbestos, several types of nylon, Dacron, Orlon, Refrasil and possibly Teflon and graphite cloth. Epoxies and phenolics are some of the resins that will be studied.

Houghton Changes Name

Houghton Laboratories, Olean, N.Y., has announced that it has changed its name to Hysol Corp., which the firm believes more accurately reflects the full scope of its products and services. Donald Roon, president of the company, states that while the word Laboratories is no longer a part of the name, there is no lessening of the firm's emphasis on research and development. The company was founded in 1949 and is said to have been the first in its field to offer commercial lines of epoxy adhesives and electrical insulation products to industry.

AMA Plans Meeting

American Management Association New York, N.Y., will hold its annual National Packaging Conference and Exposition on April 4 to 6 at Convention Hall in Atlantic City, N.J. Over 1,000 persons are expected to attend the conference, which has as its theme, "Packaging for Profit." More than 25,000 persons are expected to attend the packaging exposition, which will feature displays, by 335 exhibitors, of the latest in packaging machinery, materials and methods.

Speaking at the conference will be Orlin E. Johnson (Bristol-Myers), who will discuss the question "Are You Ready to Package in the 60's?" "Packages, Products, and Profit and Loss Statements" will be the subject of an address by Gordon C. McNown (Mead, Johnson).

J. W. Kirsch (Kirsch & Co.), R. L. Lozon (Glidden), and F. W. Priess (Montgomery Ward) will describe their companies' packaging operations. Other speakers at the conference sessions will be S. L. Torno (Danforth Wines), R. P. Gardner (S. C. Johnson), Donald L. Rogers (Comet Rice), and Glen Nowothy (Ray-O-Vac).

Cork-Tex Wall Covering

A new vinyl-on-cork wall covering reported to be able to heal itself after being punctured has been developed by Bond Crown and Cork Division of Continental Can Co., New York, N.Y. The company states that the product, called Cork-Tex Wall Covering, has been tested on the classroom walls of several West Coast schools. Designed to meet home decorating and maintenance problems, the material consists of heavy gage vinyl permanently bonded to a quarter-inch of cork. Within seconds it closes up punctures made by thumbtacks, pins, nails, and even knives, leaving the wall looking as if no damage had been made, the company states.

Permafuse Names Lipe

Permafuse Corp., Westbury, N.Y., has appointed Cord Lipe as chief engineer, adhesives. S. G. Tilden, president of Permafuse, states that Mr. Lipe will be in charge of adhesive production and the development of new adhesives. Mr. Lipe formerly was manager of the Adhesives Division of the Cycleweld Division of Chrysler Corp.

Particle Board Group

A new group, the National Particle Board Association, has recently been formed and reports that its major activity will be to establish industry standards. David C. Greeley (Weyerhaeuser) has been named first president of the association, which will have its main office in Washington, D.C. Nineteen companies are charter members of the new group. They are: Brownsville Particle Board & Associated Products, Inc., Brownsville, Ore.; Carolina Forest Products, Inc., Wilmington, N.C.; Chapwood, Inc., Philomath, Ore.; Formica Corp., Farmville, N.C.; Gray Products Co., Inc., Waverly, Va.; International Paper Co., Longview, Wash.; National Starch & Chemical Corp., New York, N.Y.; Pacqua, Inc., Dillard, Ore.; Pope & Talbot, Inc., Portland, Ore.; Rock Island Millwork Co., Rock Island, Ill.; Roddiscraft, Inc., Marshfield, Wisc.; Superwood Corp., Duluth, Minn.; Swain Industries, Seymour, Ind.; U.S. Plywood Corp., New York, N.Y.; West Virginia Pulp & Paper Co., Tyrone, Penna.; Weyerhaeuser Co., Tacoma, Wash.; Willamette Fiber & Chipboard Co., Sweet Home, Ore.; Wood Fibreboard Co., Albany, Ore.; and Wynnewood Products Co., Jacksonville, Texas.

Permacel at Olympics

Red, yellow and blue plastic tape, manufactured by Permacel, New Brunswick, N.J., was used at the recent 8th Winter Olympics at Squaw

Valley, Calif., to wrap Slalom poles which marked the downhill skiing courses. Permacel donated the tape, which is used industrially for aisle marking, wire color coding, etc.

SPI Holds Conference

The Reinforced Plastics Division of The Society of the Plastics Industry held its 15th Annual Conference on February 2 to 4 at the Edgewater Beach Hotel in Chicago, Ill. Over 1,000 persons, representing business, industry, research, development and the military, attended the three-day meeting. Eighty papers were presented, in three concurrent sessions, on aircraft and missiles, consumer products, transportation, material, electronics, design for plastics tooling, physical characteristics, processing and research. The products covered by the papers included radomes, missiles, fire arms barrel, decorative laminates, structural panels, submarine superstructures, underwater weapons, filament wound structures, master models, patter boards, boats, pre-impregnated fabrics, trailers, motor truck cabs, life boats, joints on concrete pipe, reinforced plastic pipe, honeycombs, premixes and shelters.

Armour Opens Plant

A new industrial adhesives plant, equipped to formulate animal-base, resin-base, vegetable-base and blood adhesives, has been opened in Philadelphia, Penna., by Armour Alliance Industries, Alliance, Ohio. Containing over 15,000 square feet of floor space and equipped with modern thermostatically controlled, stainless steel equipment, the new plant will service industrial adhesive customers throughout the eastern United States. The plant contains space for storage and complete packaging and shipping facilities, in addition to office and laboratory facilities for use by Armour adhesive sales and technical service personnel. The Philadelphia plant is the third in a series of new industrial adhesive plants built by Armour within the past year. Armour has adhesive plants in Chicago, Ill.; St. Paul, Minn.; Fort Worth, Texas; Omaha, Nebr.; and Alliance, Ohio.

New Riegel Office

Riegel Paper Corp., New York, N.Y., has opened a new branch sales office in Indianapolis, Ind., at 150 West Market Street. C. W. Hoffman, Midwest sales manager for packaging material sales, will be in charge of the new office, the company states. Riegel sales personnel formerly located at its Edinburg, Ind., plant have been transferred to the new office.

3M Elects Two

Louis F. Weyand, previously executive vice-president and director of sales, has been elected vice-chairman of the executive committee of Minnesota Mjning & Manufacturing Co., St. Paul, Minn. The company also announced the election of J. F. Whitcomb as divisional vice-president in charge of the Coated Abrasives and Related Products Division. Mr. Whitcomb previously was general manager of the division.

Mr. Weyand joined 3M in 1915, and progressed through the firm's sales organization to become sales manager of the Adhesives, Coatings and Sealers Division in 1941. In 1944 he was named general manager of the division. He became a vice-president in 1946 and executive vice-president for tape and allied products in 1952. Mr. Weyand was named director of sales in 1955. Mr. Whitcomb joined 3M in 1935 and held a number of sales management posts in the Coated Abrasives and Related Products Division before being named divisional general sales manager in 1955. He was named general manager of the division in 1959.

General Latex Expanding

General Latex & Chemical Corp., Cambridge, Mass., reports that its Ohio Division, General Latex & Chemical Corp. of Ohio, Ashland, Ohio, has started production and sale of resin and dextrine adhesives. Already producing and selling latex adhesives, the company plans to serve industries in Ohio, Michigan, Indiana, Kentucky and Illinois with its new adhesives line. According to the company, the addition of the new line is the beginning of its plan to produce all types of adhesives in its Ohio, Georgia, North Carolina, Massachusetts and Canadian plants.

Chase Laminating Merges

The Laminating Division of Chase & Sons, North Quincy, Mass., has merged with Foster Associates to form a new electrical insulation company known as Chase-Foster, Inc. Headquarters of the new company is located in Providence, R.I. Frank B. Foster, president of the merged company, states that production equipment for the manufacture of laminated and coated insulation products has been installed and is in production. The products will be marketed under the direction of John D. Deacon, vice-president and sales manager of the new company.

R. B. Jamison

Named Sales Director

R. B. Jamison has been named national director of sales, Eastern Division of H. B. Fuller Co., St. Paul, Minn. According to the company, Mr. Jamison's new post is part of its reorganization and strengthening of coordination between its various divisions. Mr. Jamison will be working with Fuller sales representatives in contacting purchasers of adhesives who have plants in the eastern half of the United States. He joined Fuller in 1949 as a sales representative in Wisconsin. Since 1957 he had been sales manager of the firm's largest operating plant in Cincinnati, Ohio.

Roberts Names Agents

Roberts Co., City of Industry, Calif., has added six new distributors to handle its line of Anchor-Weld contact cement. Interstate Wholesale Corp., Syracuse, N.Y., will distribute Anchor-Weld in the Syracuse, Binghampton and Utica areas. Penn-Valley Plywood, Inc., Philadelphia, Penna., will distribute the line in southern New Jersey, eastern Pennsylvania and New Castle County, Delaware. Anchor-Weld will be distributed in a 50-mile radius of Madison, Wisc., by Glassner Plywood & Door Sales. Wollen-Doyle, Inc., Paterson, N.J., will supply Anchor-Weld to customers in northern New Jersey and two southern New York counties. Distributing in Tennessee, northern Alabama, northern Mississippi and southern Kentucky will be Tennessee Metal Mouldings, Nashville, Tenn. Wright Wholesale Hardware, Inc., Santa Barbara, Calif., will distribute Anchor-Weld in the three California counties of Ventura, Santa Barbara and San Luis Obispo.

Plan Building Congress

More than 60 companies have already contracted for space at the first Industrial Building Exposition & Congress to be held on December 12 to 15, 1960, at the New York Coliseum in New York City. It has been reported that the exhibits at the exposition will fall into eight major categories, including structural products, such as foundations, floors, walls and windows; mechanical products and systems for operating efficiency, such as conveyors, elevators and waste-disposal systems; electrical, such as power distribution, lighting and process control; heating and air conditioning equipment; employee services; plant sites and services offered by states and municipalities, transportation, power and water; financial services; and auxiliary services, such as landscaping and parking. Held concurrently with the exposition will be the first Industrial Building Congress. The congress will examine and discuss major facets of industrial building and modernization.

UC Plastics Names Five

Union Carbide Plastics Co., New York, N.Y., in a series of personnel shifts, has announced that Herbert R. Clark has been appointed a technical representative in the Technical Service Department at Bound Brook, N.J., while Richard G. Hess has been assigned to Rochester, N.Y., to handle flexible packaging, bonding and laminating seals for the upper New York State area. Howard J. McCurdy has been appointed technical sales representative in the South Atlantic regional office at Moorestown, N.J., and Charles W. Naylor has been named sales trainee in the Midwestern office at Chicago, Ill. Douglas L. Peterson has been assigned to the North Central regional office in Cleveland, Ohio, as a sales trainee.

Triples Resin Output

Naugatuck Chemical Division, U. S. Rubber Co., Naugatuck, Conn., reports that it has more than tripled the capacity of its Marvinol vinyl resin plant in Painesville, Ohio, since it acquired the plant ten years ago. According to the company, an additional expansion program now underway will raise the plant's capacity by more than 30 per cent, and when the project is completed in July the plant will have an approximate capacity of 65 million pounds annually.

Form Key Polymer

Jacob Lichman, Sydney Comins and Adrian Comins have formed Key Polymer Corp. in Lawrence, Mass., to develop and produce adhesives and coatings from epoxy and polyurethane polymers. It is reported that the new company is exploring present and future markets for epoxies and polyurethanes. In addition, specialty adhesives and coatings will be developed in cooperation with selected customers. The company also will have available a custom manufacturing service.

Mr. Lichman has been named general manager and treasurer of the new company. He is a graduate of Boston University and was one of the founders of American Resinous Chemicals Corp., serving as production manager until 1947, when he became vice-president in charge of sales. In 1952, he joined American Monomer Corp., as general manager, and in 1954 returned to American Resinous as vice-president in charge of research. In December, 1955, when Borden Co. acquired American Resinous, Mr. Lichman was named manager of its research laboratory at Peabody, Mass., as well as the technical service laboratories at Middlesex, N.J.; Chicago, Ill.; and Toronto, Ont. In 1958, Mr. Lichman was named a member of the Editorial Advisory Board of ADHESIVES AGE.

Wallace Joins Seal-Kap

David W. Wallace, formerly executive vice-president and secretary of the Alleghany Corp., has been appointed executive vice-president of American Seal-Kap Corp., New York, N.Y. In his new post, Mr. Wallace will assist E. M. Black, Seal-Kap president, in coordinating the financial operations of the various enterprises which the company owns or in which it has interest. He also will work with Mr. Black in broadening the management capabilities of these companies and in the expansion of the existing operations as well as analyzing and screening possible new acquisitions. American Seal-Kap's operations include American Seal-Kap and Constellation Cup Divisions; Chicago Railway Equipment Co.; National Lock Washer Co.; and National Rubber Machinery Co. Mr. Wallace joined Alleghany Corp. in 1954 as resident counsel and later was elected secretary and treasurer. In 1956, he became vice-president, retaining the office of secretary. Subsequently, he was named executive vice-president.

FMC Names Oskin

Donald C. Oskin has been named to the newly created position of vice-president of executive sales of the Chemical Divisions of Food Machinery & Chemical Corp., New York, N.Y. He also was appointed a member of the executive committee of the Chemical Divisions. In his new post, Mr. Oskin will maintain contact with the top management of the major customers of the five chemical divisions of FMC. These divisions are Becco Chemical, Chemicals and Plastics, Chlor-Alkali, Mineral Products, and Niagara Chemical. A graduate of Lehigh University, Mr. Oskin joined FMC in 1945. He served as Detroit district sales manager, then became manager of alkali sales and later manager of phosphate sales. In 1950, he was appointed director of district office sales for the Chlor-Alkali and Mineral Products Divisions. He became assistant general sales manager for the Mineral Products Division in 1954.

UC Fibrous Resins

Vinyl and styrene polymers in the form of highly oriented fibers are available in developmental quantities from Union Carbide Plastics Co., New York, N.Y. Fiber lengths vary from very short to a maximum of 3/16 inch, and the fibers are very irregular in shape with diameters ranging from 2 to 200 microns. The vinyl resin is designated VXKA-6112 and the styrene resin SXKA-0121. According to UC, the new Bakelite Brand Fibrous Resins appear to have application in the preparation of specialty papers, in pulp and paper molding, and in laminates. In the textile field, the fibrous resins are being evaluated as binders for nonwoven textiles, the company reports.

Maine Offering Courses

The Summer Institute of the University of Maine, Orono, Maine, is offering two three-week courses on pulp and paper technology designed to broaden the technical and management training of key personnel in the pulp and paper industry. The first course, Pulp Technology, will commence on July 11 and run through July 29. The second course, Paper Technology, will be conducted from August 1 to 19. The Pulp Technology program will consist of three courses, Pa 1s Pulp Technology, Theory, Pa 2s Pulp Manufacture and Testing, and Pa 2as Instrumentation, an alternate course for Pa 2s. The Paper Technology program consists of Pa 3s Paper Technology Theory, Pa 4s Paper Manufacture and Testing, and Pa 4as Instrumentation, an alternate for Pa 4s. Additional information about the courses and tuition can be obtained from Prof. Lyle C. Jenness, Director, Summer Institute for the Pulp and Paper Industry, Aubert Hall, University of Maine, Orono, Maine.

Develops Epocast H-1153

Furane Plastics, Inc., Los Angeles, Calif., has announced the development of Epocast H-1153 for use in the application of epoxy-glass lining to wooden pallets. According to the company, this development greatly extends the serviceability of wooden pallets, permitting a larger number of products to be handled. Splintered wood projections and rough edges which ordinarily tear packaging films are virtually eliminated through a protective overlay of glass cloth and epoxy resins, the company states. In making the epoxy-glass linings, a special fluid and impregnating grade of epoxy is combined with an appropriate safety hardener and the combination brushed on glass tape, surfacing the wooden pallet strips. Furane reports that the materials will set rapidly at room temperatures, permitting the pallets to be put into use with a minimum of lost time.

Plough Buys Company

Plough, Inc., Memphis, Tenn., manufacturer of proprietary drugs, has purchased Dicks-Armstrong-Pontius, Inc., Dayton, Ohio, producers of caulking compounds. According to reports, the acquisition was accomplished by exchanging 50,053 shares of Plough stock for all of the outstanding shares of Dicks-Armstrong-Pontius.

UC Coating Compound

The development of a new high-density polyethylene extrusion coating compound, said to be a major economic breakthrough in the paper packaging industry, has been reported by Union Carbide Plastics Co., New York, N.Y. The material, designated DGDD-7401 Natural, virtually cuts in half the coating weights required to give paper excellent impermeability to moisture, grease and oils, the company states. It is claimed that DGDD-7401 can be extruded onto paper at good commercial speeds in coating weights as low as six pounds per ream. According to UC, 20 pounds per ream formerly was the lowest practical coating weight possible with high-density polyethylene.

Data obtained in the laboratories of Union Carbide Plastics shows that the moisture protection offered by a six pound per ream high-density polyethylene coating surpasses that of asphalt/paper laminated constructions commonly used for shipping highly moisture-critical products. In addition, DGDD-7401 Natural gives protection against deterioration from high acid/alkali products, and gives multiwall bags superior scuff and abrasion resistance, improved slip properties and higher heat resistance, the company states.

GE Building Resin Plant

Construction is in progress on what is reported to be the first self-contained polycarbonate resin manufacturing plant in the United States. The plant is being built alongside the Ohio River near Mount Vernon, Ind., by the Chemical Materials Department of General Electric Co., Pittsfield, Mass. According to the company, this multimillion dollar, multi-million pound per year commercial plant represents a further scale-up of semi works and pilot plant facilities that have operated since early 1957 at Pittsfield, and from which more than 200 production applications for its Lexan polycarbonate resin are being supplied. The new facility is expected to be in operation in the third quarter of 1960.

Borden Buys Ink Firm

Borden Chemical Co., New York, N.Y., has acquired the Commercial Ink & Lacquer Co. of Fair Lawn, N.J., and Whitehouse, Ohio, and will operate the unit as the Ink and Lacquer Department. Borden states that no major change in policy or personnel is planned. With its new acquisition, Borden will be able to supply paper converters with a complete line of products including laminating adhesives, adhesives for fabrication, coating chemicals, etc. James A. Wold, formerly general manager of Borden's Consumer Products and Resinite Departments, has been named general manager of the new Ink and Lacquer Department. John R. Stanley has succeeded Mr. Wold as general manager of the Consumer Products Department. Mr. Wold has been with Borden since 1954. Mr. Stanley joined the company in 1959.

MCA Construction Survey

Construction of plastics and resins production and research facilities costing an estimated $274,080,000 will be completed during 1960 and 1961, according to a recent survey made by the Manufacturing Chemists' Association. The figure includes $183,240,000 for construction already begun and $90,840,000 for projects scheduled for early ground breaking and completion before 1962. The two-year figure represents about a 60 per cent increase over the 1959 construction total of $176 million. With a three-year, 1959-1961, total of $450,080,000, construction of plastics and resins facilities ranks fourth, in total chemical plant construction, behind general inorganic chemicals, general organic chemicals and petrochemicals. Following plastics and resins, which accounts for 15 per cent of the three-year construction investment of $3.002 billion, are general laboratories, fertilizer chemicals, synthetic fibers, and synthetic rubber.

Presto Company Formed

A new company, Presto Adhesive Paper Co., Glendale, Calif., has been formed to manufacture pressure-sensitive adhesive paper stocks for the graphite arts field. The company reports that equipment is being installed for production of roll stock and is expected to be in operation in April. The equipment is custom-made for gumming and laminating and is said to provide high speed production under rigid quality control. A wide variety of papers and finishes will be available.

Murray McDougal has been named president of the newly formed California corporation, and James Rieger, president of Presto Adhesive Paper Co. of Ohio, has been named vice-president and director of the new firm. Mr. McDougal was a founder and president of Archer Label Co.

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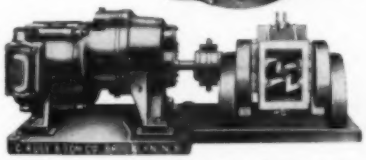

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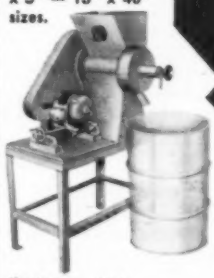

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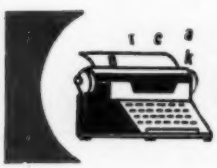

names in the news

Irving Paeff has been appointed by Schwartz Chemical Co., Long Island City, N.Y., as its southern representative with headquarters in North Miami, Fla.

Augustine LaTorre has joined the research laboratory staff of Polyvinyl Chemicals, Inc., Providence, R. I.

Joh. Kist, of Amsterdam, Holland, has been appointed its European representative by Parker Seal Co., Culver City, Calif.

John A. England, Jr., been appointed secretary-treasurer of U B S Chemical Co., Cambridge, Mass. He succeeds **Charles V. Glynn,** who has been elected comptroller of A. E. Staley Mfg. Co., Decatur, Ill., parent company of U B S.

Charles J. Chaban, research director in charge of coated and processed fabrics of Landers Co., Toledo, Ohio, has been elected vice-president for research.

Dennis Lietz has joined Colton Chemical Co., Cleveland, Ohio, as a research chemist in the Polymer Section.

Francis J. Honn, formerly with Minnesota Mining & Mfg. Co., has been named technical director of Carter's Ink Co., Cambridge, Mass.

Richard H. Dillinger, formerly with Paisley Products, Inc., has been appointed assistant manager of the Paper Division of Morningstar-Paisley, Inc., New York, N. Y.

H. W. Tripp has been elected to the board of directors of Wallace & Tiernan, Belleville, N. J.

Paul B. Hanrahan has been named technical sales representative in the midwestern region by Union Carbide Plastics Co., New York, N. Y.

C. J. Lee, previously with Avery Label Co., has been named East Coast area representative for Morgan Adhesives Co., Stow, Ohio.

Ralph E. Eckerstrom has been appointed director of advertising and public relations for Container Corp. of America, Chicago, Ill., in addition to his current post of director of the firm's Department of Design.

G. A. Kolman has been appointed to the newly-created post of operations manager of the research center of General Foods in Tarrytown, N. Y.

Jerome D. Bassin, formerly epoxy group leader at Borden Chemical Co., has formed KDK Plastics Co., Harpursville, N. Y.

M. A. Burnston has joined the Technical Association of the Pulp and Paper Industry, New York, N. Y., as a member of its permanent headquarters staff.

Dr. W. M. Lair becomes director of research and development at the newly-completed research and development center of Continental-Diamond Fibre Corp. in Newark, Del. **A. H. Haroldson** has been named associate director at the center.

Erhart K. Drechsel has been named manager of new product development for the Commercial Development Department of Escambia Chemical Corp., New York, N. Y.

Dr. Fred P. Baughman, previously with DuPont, has joined the Technical Department of Taylor Fibre Co., Norristown, Penna., as group leader.

H. K. Lauer, formerly associated with Minnesota Mining & Mfg. Co., has joined the staff of the reliability and quality assurance laboratory of Hughes Aircraft Co., Fullerton, Calif.

Chi Chang has joined the technical staff of Minnesota Mining & Mfg. Co., St. Paul, Minn.

Stanley F. Brenegan has been appointed general sales manager for Canadian Resins and Chemicals Ltd.

Dr. Jerome J. Ross, previously with Hampshire Chemical Co., has joined the Research Department of Food Machinery & Chemical Corp.

Dr. Walter H. Prahl, director of Phenol research and development of the Durez Plastic Division of Hooker Chemical Corp., has recieved the 8th Annual Professional Achievement Award of the Western New York Section of the American Institute of Chemical Engineers.

Dr. J. Peter Kass, previously director of research with Pabst Brewing Co., has joined Armour & Co. as director of its Central Research Laboratories.

Sam I. Kohen has joined Stein Hall & Co. as technical representative to the petroleum industry.

Herbert W. Hamilton, secretary of the Chemical Specialties Manufacturers Association, has been named to receive the association's 1959 Achievement Award.

Melvin Hochberg has been elected to the board of directors of Nopco Chemical Co.

Robert D. Forger has been named administrative assistant for the Society of Plastics Engineers.

Dr. F. S. Mortimer and **Dr. C. D. Wagner,** research chemists, have been named supervisors of research at Emeryville Center of Shell Development Co.

Howard W. Comey, formerly sales technical representative for Borden Co., has joined Borden Chemical Co., Leominster, Mass., in new product development.

Thomas J. Evensen has joined the duplicating products laboratory of Minnesota Mining & Mfg. Co., St. Paul, Minn., as senior chemist.

John N. Guidice has been named sales representative for the Resin and Chemical Division of Catalin Corp. of America, Chicago, Ill.

Bruce Ainsworth, formerly assistant to the vice-president in charge of Chemical Divisions, has been appointed president of the Harchem Division of Wallace & Tiernan, Belleville, N. J.

Herbert L. Wampner, director of research of Reichhold Chemicals, Inc., White Plains, N.Y., has been elected to the firm's board of directors.

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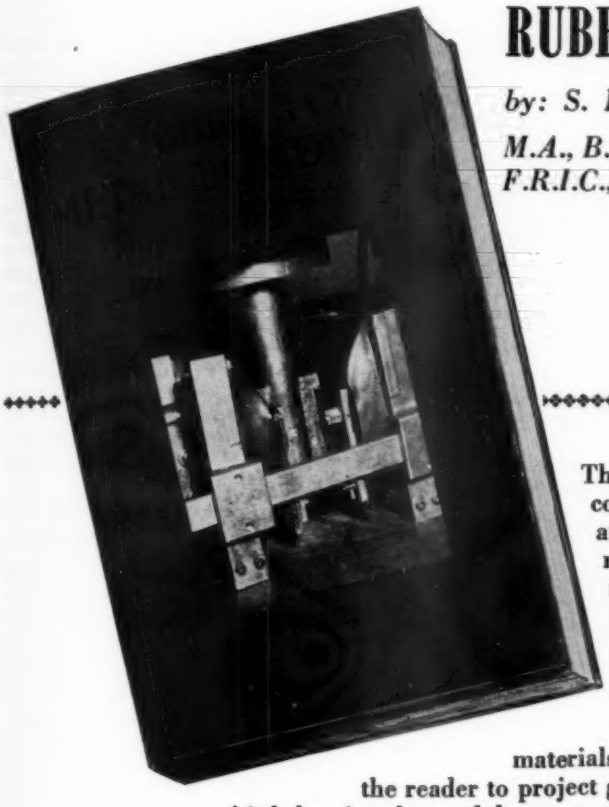

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Inorganic research previously conducted by many of its branches throughout the country has now been consolidated by the Glidden Co. in this central laboratory at Baltimore, Md.

Glidden Opens New Research Center

The Glidden Co., a major producer of paints and chemicals, opened a new inorganic research and development center costing over $1 million, on the outskirts of Baltimore, Md., February 3. The center consolidates the firm's research, product development and technical service facilities for the paper, paint, rubber and plastics industries.

The two-story research center is located at 3901 Hawkins Point Road, adjacent to Glidden's Adrian Joyce Works, one of the country's largest titanium dioxide manufacturing plants. One of its most noteworthy features is a paper making laboratory that contains advanced equipment for reproducing the entire cycle from pulp to testing of coated product in miniature. Fundamental and applied research on paper at this lab and at sponsored university projects will be disseminated to the paper industry as a free service by Glidden.

Investigations into paper coating will include technical studies of adhesives such as starch, alpha protein, milk casein and synthetic latices. Latex bases are also being studied in the paint laboratory which combines product control with research and development functions. The third unit, the plastics and rubber laboratory, is concentrating on pigments and their effect on opacity, dispersion and color.

The latest research equipment is in evidence at the laboratories. Color studies are being conducted with a reflectance spectrophotometer, an X-ray system handles analyses of crystalline structures, an electron microscopy unit is also engaged in crystal investigations, and a 13-meter emission spectrograph facilitates rapid chemical analyses. The emphasis of all product development work with these facilities is on the two varieties of titanium dioxide, rutile and anatase.

This work was formerly centered at Glidden's plant in St. Helena, also a suburb of Baltimore, which remains the site of cadmium pigment operations. The company's organic research continues to be done at its Jacksonville, Fla., installation. The new center is eventually slated to become headquarters of product development and technical services exclusively. Glidden has just purchased land near its Cleveland, Ohio, home office, where it plans to erect a central research laboratory.

Herbert L. Rhodes is manager of the new inorganic research and development center. A. C. Dreshfield has been named director of paper research; C. A. Tanner Jr., director of development; Dr. Reuben Roseman, director of research; Richard W. Dye, supervisor of the instruments and plastics-rubber laboratories, and George B. Taylor, director of the paint service laboratory.

Hamilton Takes New Post

James S. Hamilton, assistant to the president of Potdevin Machine Co., Teterboro, N.J., has been named vice-president in charge of sales of the Bag Machine Division of Potdevin. During his 25 years with the company, Mr. Hamilton has served as a sales representative and advertising manager.

Rubba Labeling Adhesives

Rubba-Peel, a new labeling adhesive said to eliminate the need for expensive pressure-sensitive labels on polyethylene, polystyrene, metal and other surfaces has been developed by Rubba, Inc., New York, N.Y. The company states that removable labels can be adhered instantaneously with Rubba-Peel without the need for removing a release paper prior to application. The new adhesive is reported to be non-inflammable and can be applied by brush or inexpensive labeling machines. It will adhere tenaciously, yet, when desired, labels can be peeled easily from glass, plastics, metals and other materials without leaving any sticky residue, the company states. Rubba, Inc., recommends its use in labeling toys, novelties, housewares and other products which require easily removable labels and wherever a pressure-sensitive label is desired at lower cost.

Shawinigan Names Cohen

Dr. Saul M. Cohen has been appointed a group leader in the Research Department of Shawinigan Resins Corp., Springfield, Mass. The company reports that in his new capacity, Dr. Cohen will organize a research group which will be responsible for exploratory research in the synthesis of totally new plastic resins. Dr. Cohen received his B.S. degree in chemistry in 1948 from the University of Massachusetts, and was awarded his M.S. degree in 1950 and his Ph.D. degree in organic chemistry in 1952 from the University of Illinois. He joined Shawinigan in 1954 as a research chemist in the Research Department. Dr. Cohen is a member of the ACS.

Staley Promotes Hise

A. E. Staley Manufacturing Co., Decatur, Ill., has announced the promotion of its purchasing agent, H. H. Hise, to division manager. Mr. Hise's promotion followed the firm's announcement that its purchasing organization would be given division status in recognition of the growing scope and importance of purchasing activities under Mr. Hise's management. In his new position, Mr. Hise will continue in charge of Staley's purchasing organization, which he has headed for the past 15 years and which he has been associated with during all of his 34 years with the company. The purchasing organization previously was a department of the Manufacturing Division.

BRI Featuring Adhesives

The use of adhesives for drywall construction, for bonding cementitious materials, and in the lamination of structural timber beams will be topics at a two-day conference during the Spring Conferences of the Building Research Institute on April 5 to 7 at the Statler Hilton Hotel in New York City. The technical program for the adhesives conferences has been developed under the chairmanship of George J. Schulte (Minnesota Mining & Mfg.).

Experts in the field will discuss the problems connected with laminated structural beams, such as the development of wood sealers that can be finished after fabrication; improved waterproof adhesives which will reduce production time and cost; accelerated testing methods for laminated bonds; and improved adhesives for scarf joints.

A second section of the meeting will detail the progress made in recent years in the development of bonding agents for cementitious materials, including plaster as an interior finish and the bonding of thin structural overlays of concrete and heavy concrete structural members. A third session will deal with the bonding of drywall. Three phases of drywall construction will be especially stressed; attachment of gypsum drywall to studs; lamination of gypsum drywall; and joint finishing and spotting nail heads.

New Isochem Resin

A new resin series, designated Isochemres 450, said to offer lowest possible viscosity plus 100 per cent epoxy solids without the use of reactive or other diluents, has been developed by Isochem Resins Co., Providence, R.I. The company reports that all conventional hardeners may be used with the new 450 systems. In addition, the systems furnish excellent electrical and physical properties and minimize air entrapment in filled or unfilled resins, the company states.

FMC Appoints Burnett

Dr. Leo S. Burnett has been named technical director of the Dapon Department for the Food Machinery and Chemical Corp., New York, N. Y. Dr. Burnett graduated from Columbia University and was formerly manager of plastics research for the Energy Division of the Olin Mathieson Chemical Corp.

Isochem Reorganizes

Isochem Resins Co., Providence, R.I., has been formed out of the reorganization of the corporate structure of the recently-dissolved firm, Isochem Resins Corp. According to the company, the reorganization was made in order to implement efficiently the rapid expansion brought about by widespread customer acceptance of its line of specialized epoxy and polyester resin formulations. The company reports that, at the outset, it plans to offer the same line of formulated resins and adjuncts as in the past. Isochem Resins will continue to occupy, for the present, the same premises at 221 Oak Street in Providence. In addition, its network of distributors will be retained for the most part. The company also announced that Alfred L. Smith, Jr., peviously with Kaiser Aluminum & Chemical Corp., has joined the firm as plant manager.

Catalin Plant Opened

Catalin Corp. of America, New York, N.Y., has begun full scale production at its new ten million pound per year acrylic resin plant in Fords, N.J. Based on a cross-licensing agreement with Union Chimique Belge, S.A., Brussels, Belgium, the Fords plant's design and process equipment is patterned partially on a mutual exchange of technical information and know-how with Union Chimique. Designed for flexibility in production, the new plant is producing a variety of acrylic emulsions and solutions tailored specifically for use in the manufacture of such diverse products as paints and coatings, textiles, paper, leather, adhesives, and others, the company states.

USDA Starch Study

A report based on studies made by the Northern Utilization & Development Division of the U.S. Department of Agriculture, Peoria, Ill., reveals that dialdehyde starch may replace melamine in the production of wet strength paper. The USDA report states that dialdehyde starch can be impregnated into the paper during wet-end processing, thereby eliminating some of the difficulties encountered in applying melamine to finished paper. In addition, the wet strength of starch treated paper is comparable to that provided by melamine, and is as high as 53 per cent of dry strength.

GIA Seminar Hears Mark

Prof. Herman F. Mark (Polytechnic Institute of Brooklyn) was the principal speaker at Third Annual Gummed Industries Association Technical Section Seminar which was held on February 25 at the Hotel Roosevelt in New York City. Dr. Mark, director of polymer research at Brooklyn Polytechnic, discussed the principals of adhesion, new adhesives, and related matters of direct interest to the gumming industry.

Keith H. Williams (Mid-States Gummed Paper) was unanimously elected chairman of the GIA Technical Section, and Henry C. Hills (Nashua Corp.) was elected section vice-chairman. Other business carried on during the seminar was the presentation of reports on the subjects of adhesive testing, waste paper utilization, and standard laboratory test procedures. The Technical Section approved, for 1960, an expanded program calling for the establishment of subcommittees along product lines and the development and publication of a GIA Standard Test brochure, the first copies of which will be released in the near future.

Buys Narmco Industries

Narmco Industries, Inc., San Diego, Calif., has been purchased by Telecomputing Corp., Los Angeles, Calif. W. R. Whittaker, president of Telecomputing, reports that the purchase transaction is based on the exchange of one share of Narmco stock for two shares of Telecomputing stock. According to Mr. Whittaker, Narmco will operate as a wholly-owned subsidiary of Telecomputing. Narmco management will remain the same with Dr. Glenn G. Havens still serving as board chairman and David L. Grimes continuing as president.

Devcon Forms Division

Devcon Corp., Danvers, Mass., has formed an Automotive Division for the marketing of its Plastic Steel Auto Repair Kit, Devcon Rubber Auto Repair Kit and three new products, Devcon 2-Ton, Devcon Liquid Aluminum and Devcon Steel. The new division will also supervise the development of new automotive products and the appointment of new distributors. The company also announced that E. Leslie Hall, Devcon vice-president and general sales manager, has been named general manager of the new Automotive Division.

April 4-7. American Management Association, National Packaging Conference and Exposition, Convention Hall, Atlantic City, N.J.

April 4-5. Industrial Accident Prevention Association, Annual Conference, Royal York Hotel, Toronto, Ontario, Canada.

April 4-7. 1960 Nuclear Congress, New York Coliseum, New York, N.Y.

April 5-14. American Chemical Society, 137th National Meeting, Cleveland, Ohio.

April 5-7. Building Research Institute, Spring Conferences, Statler Hilton Hotel, New York, N.Y.

April 6-9. Society of the Plastics Industry, Western Section Annual Conference, Hotel Riviera, Palm Springs, Calif.

April 18-22. American Institute of Architects, 92nd Annual Meeting, San Francisco, Calif.

April 18-19. Conference on Automatic Techniques, Sheraton Cleveland Hotel, Cleveland, Ohio.

April 19-21. Food and Container Institute, Research and Development Associates 14th Annual Meeting, Congress Hotel, Chicago, Ill.

April 20-27. "InterPak" Second International Trade Fair for Packaging Machines, Confectionary Machines and Packaging Materials, Exhibition Grounds, Duesseldorf, West Germany.

April 20. Society of Plastics Engineers, Annual Regional Technical Conference, Hotel Texas, Fort Worth, Texas.

April 24-May 3. German Industries Fair, Hanover, West Germany.

April 24-28. American Ceramic Society, 62nd Annual Meeting, Bellevue-Stratford Hotel, Philadelphia, Penna.

April 25-26. American Society of Mechanical Engineers, Maintenance and Plant Engineering Conference, Chase and Park Plaza Hotels, St. Louis, Mo.

April 25-26. Society of the Plastics Industry, Canadian Section Conference, London Hotel, London, Ontario, Canada.

April 27-29. Instrument Society of America, Sixth Annual Southeastern Conference and Exhibit, and First Pulp and Paper Division Symposium, Pensacola, Fla.

April 28-29. Forest Products Research Society, Northern California Section, Sheraton-Palace Hotel, San Francisco, Calif.

May 1-7. National Association of Architectural Metal Manufacturers, 22nd Annual Convention, Boca Raton Hotel, Boca Raton, Fla.

May 11-13. American Material Handling Society, Western Regional Material Handling Show and Packaging Cavalcade, Great Western Exhibit Center, Los Angeles, Calif.

May 15-18. International Distribution Congress and Business Aids Show, 25th Annual Meeting, Statler Hilton Hotel, Buffalo, N.Y.

May 20-31. International Plastics Exhibition, Oslo, Norway.

May 23-25. TAPPI 11th Coating Conference, Edgewater Beach Hotel, Chicago, Ill.

May 23-26. American Society of Mechanical Engineers, Design Engineering Conference & Show, Statler Hilton Hotel, New York, N.Y.

June 1-10. International Chemical Exhibition, Belgrade, Yugoslovia.

June 5-9. Forests Products Research Society, 14th National Meeting, Montreal, Quebec, Canada.

June 10-26. Federation of British Industries Exhibition, New York Coliseum, New York, N.Y.

June 13-15. 43rd Annual Conference and Exhibition of the Chemical Institute of Canada, Chateau Laurier Hotel, Ottawa, Ontario, Canada.

Portrait of

RALPH C. McGAFFIN

One of the pioneers of synthetic resin adhesive technology, Ralph C. McGaffin is the manager of Adhesive Technical Development, National Starch and Chemical Corp., New York, N.Y. Mr. McGaffin was born and educated in South Africa and joined National in 1932 as a development chemist and head of the newly formed Resyn Department.

At that time, all of the company's adhesives were based on natural polymers, and Mr. McGaffin's assignment was to develop a new type of adhesive, one that could bond the transparent films that were beginning to be used as packaging materials. His efforts were largely responsible for drawing National's attention to polyvinyl acetate as a raw material.

In his early days with National, Mr. McGaffin handled the multiple tasks of development chemist, administrator and technical service representative. In 1948, he was manager of the Resyn Department, and in 1957, he was promoted to manager of Adhesive Technical Development.

Mr. McGaffin received his B.S. degree in chemistry from the University of South Africa, and his M.S. degree from the University of Capetown. Later, he pioneered the development of the chemistry department at the Cape Technical Institute.

Join Skeist & Schwarz

Henry J. Rynkiewicz, Dr. Reinhard Eck and Henry C. Speel have joined Skeist & Schwarz Laboratories, Inc., New York, N.Y. Mr. Rynkiewicz, who will serve as laboratory director, holds an M.S. degree in chemistry from Pennsylvania State University. He formerly was with the Surgical Products Division of American Cyanamid Co., as a research chemist in mechano-electrical devices for quality control and automated production systems. Dr. Eck has been named research associate. He received his Ph.D. in chemistry from the University of Wuerzburg, Germany. He was associated for many years with United Piece Dye Works as manager of resin products research and production for textile finishes and pigment printing. Dr. Eck is a Fellow of the American Institute of Chemists.

Mr. Speel has been appointed an associate of the firm. He formerly was director of development of Wyandotte Chemical Corp. He also was associated with General Aniline & Film Corp. and Atlas Powder Co. prior to becoming a consultant specializing in surfactants and chemical economics. Mr. Speel is a graduate of Harvard University. He is secretary of the Western New England Section of the American Association of Textile Chemists and Colorists and a Fellow of the American Institute of Chemists.

Dr. Eugene W. K. Schwarz, president of Skeist and Schwarz, reports that the main office and laboratory of the firm have been established at 101 West 31st St., New York City. The original location at 89 Lincoln Park, Newark, N.J., will continue as a branch office and laboratory.

Staley Names Beaumont

A. E. Staley Manufacturing Co., Decatur, Ill., has announced the appointment of James H. Beaumont as assistant manager of its Corn Division. In announcing Mr. Beaumont's promotion, Staley reports that expanding activities of the company in starches, syrups, protein and chemical products call for a broader administration base to develop its marketing program. Prior to joining Staley in 1955 as public relations director, Mr. Beaumont had been city editor of the *Decatur Review*. The company also announced that John N. DeBoice, previously assistant public relations director, has been named to succeed Mr. Beaumont as public relations director.

Epoxy Use To Increase

Richard Schumer, president of Permagile Corporation of America, Woodside, N.Y., states that epoxy resin production in 1960 will nearly double the annual figure of two years ago. Mr. Schumer predicts that this year's production will exceed 50 million pounds for the first time. This would compare with the 1958 output of approximately 28 million pounds. The successful performance of epoxy resins, he states, is rapidly winning the confidence of plant engineers and maintenance men throughout the country. The experience of several years has given formulators the know-how which is necessary for realizing the full potential of the epoxies in varying formulations and under varying conditions, Mr. Schumer states.

FMC Appoints Knox

Chemicals & Plastics Division, Food Machinery & Chemical Corp., New York, N.Y., has appointed George H. Knox as Midwest district manager for its Dapon Department. Mr. Knox, with headquarters in Chicago, Ill., will serve users of Daponite laminated surfacing in furniture and building construction; users of Dapon resin molding compounds in electrical and electronic components; and users of Dapon resin laminates in the aircraft and missile industries. Prior to joining FMC, Mr. Knox was a sales representative for General Tire & Rubber Co.

Forms New Division

Firestone Tire & Rubber Co., Akron, Ohio, has announced the formation of a new production division for the manufacture of molded fiber products called Fibrocast. According to Firestone, Fibrocast, made from various fibers and synthetic resins, is easily molded into a variety of components for the automotive, aircraft, communications, defense and allied industries. Initial production of the new material will be for air ducts for the ventilation systems of buses and cars, automotive door panels and package trays. Fibrocast Division headquarters have been established in Akron, with sales offices in Akron and Detroit, Mich. Production facilities are at the firm's Magnolia, Ark., plant.

The company also announced the appointment of W. D. Gore as general manager of its Fibrocast Division. Mr. Gore, former sales manager for Firestone Airide air springs, attended Cornell University and graduated from the Wharton School of Finance at the University of Pennsylvania. Mr. Gore has been with Firestone since 1924 when he joined the company as a member of its first college training class. In 1946 he was named purchasing agent of the company, and in 1951 was appointed general manager of its defense products plant in Akron. In 1954 he was named director of defense activities and in 1956 became manufacturers sales manager.

3M Year-End Report

With worldwide operations fully consolidated for the first time, Minnesota Mining & Manufacturing Co., St. Paul, Minn., reports that its 1959 net sales totaled $500,675,932, and its net income, after taxes, amounted to $63,564,727, equal to earnings of $3.74 per share of common stock. In 1958, with only export and Canadian operations consolidated with those of the domestic company, sales were $376,293,016, and income was $43,879,033, or $2.58 per share. Directly comparable 1959 figures are sales of $446,580,323, and income of $60,262,440, or $3.54 per share, the company notes.

In its annual report to stockholders, 3M declared that consolidation of all foreign operations reflects the growing significance of international operations to the company. Reporting 1959 foreign sales of $95 million, compared with $79.9 million for 1959, 3M notes that its foreign sales have more than doubled since 1955 and now equal total 3M sales 12 years ago. The company states that it plans to boost research spending to about $23 million in 1960 from the $18,300,000 in 1959, and that more than 20 per cent of 1959 sales came from products not in existence at 3M five years ago.

The company also reports that two new Italian subsidiaries have been formed. The first, a trading company, took over distribution of 3M products in Italy on January 1. The second Italian company is a manufacturing subsidiary which will acquire land and begin construction during 1960. In Japan, a manufacturing and sales subsidiary has been formed, with distribution activities to begin later this year and manufacturing operations expected to start early in 1961.

patent review

By MELVIN NORD

Shock-Resistant Adhesive Tapes

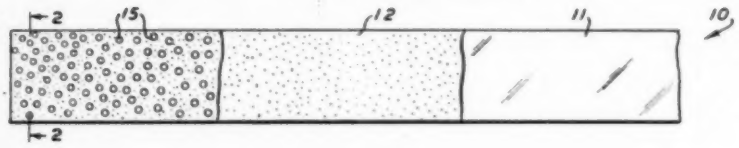

Figure 1

U. S. Patent 2,911,318, issued Nov. 3, 1959 to Brooke W. Lerch, assigned to Western Electric Co., Inc., provides pressure-sensitive tapes that are flexible and have a high resistance to shock or impact. These two features are particularly desirable in electrical cables used in the communications industry.

Figures 1 and 2 illustrate a tape (10) which is shown to have a backing strip (11) made of any suitable material, such as cellulose acetate or cellophane. One surface of the backing strip is covered with a coating (12) of the pressure-sensitive adhesive material. If the plastic strip is active with respect to the pressure-sensitive adhesive coating, the opposite surface of the strip may be covered with a sizing coating (not shown) of a resinous varnish which is inactive with respect to the pressure-sensitive adhesive coating. The sizing coating permits the tape, which is normally wound into rolls, to be unwound readily. Examples of materials that may be used to form such a sizing coating are shellac and glue.

Figure 2

The pressure-sensitive adhesive coating may be prepared by applying to the backing strip a known type of adhesive solution or dispersion which adheres tenaciously to the strip. Examples of suitable adhesives that may be used to form the coating are compounds including a polymerized isobutylene elastomer and a hydrogenated resin of a class comprising hydrogenated indene resins, coumarone resins, dicyclopentadiene resins and combinations thereof combined in proportions adapted to form a normally-tacky, pressure-sensitive adhesive coating. Such a compound is dispersed in a sufficient quantity of a volatile vehicle to make a thick mass which may be spread upon the backing strip.

Upon evaporation of the volatile vehicle, by heating, there is left a normally-tacky, pressure-sensitive adhesive coating. Such a pressure-sensitive adhesive is normally-tacky, nondrying and is stable in a condition such that it need not be activated by solvents or heat or otherwise processed in order to secure tenacious adherence to susceptible surfaces.

To increase the shock resistance of the tape without subjecting the tape to the disadvantage of not being able to withstand repeated torsion, a number of particles (15) of a resilient, cushioning material are dispersed on and held securely by the exposed surface of the pressure-sensitive adhesive coating. The particles may be made of cured rubber, or other rubber-like or shock-resistant material, such as synthetic rubber or neoprene. The particles may be in the form of small discs, as shown.

The spacing of the discs is not critical and any number of discs can be provided depending upon the amount of shock or impact resistance that is desired. The only obvious requirement is that suitable spaces exist between the discs to permit the pressure-sensitive adhesive coating to adhere to any susceptible surface with which it may come into contact.

Heat Softenable Adhesive Supply Bodies

U. S. Patent 2,912,398, issued Nov. 10, 1959 to Eric C. Johnson and Robert D. Clarke, assigned to B. B. Chemical Co., describes an article for supplying thermoplastic

Other Patents of Interest

Subject	Inventor or Assignee	Patent No.	Date
Tape dispenser	Federal Tool Corp.	2,910,217-8	10/27/59
Adhesive applying device	Package Machinery Co.	2,911,942	11/10/59
Label dispenser	Kleen-Stik Products, Inc.	2,912,140	11/10/59
Pressure-sensitive tape	Johnson & Johnson	2,912,348	11/10/59
Box gluing machine	Allied Container Corp.	2,912,908	11/17/59
Adhesive applying device	The American Envelope Co.	2,912,959	11/17/59
Roll type glue spreaders	Robert S. Black et al.	2,912,960	11/17/59
Adhesive tape with low adhesion backsize coating	Johnson & Johnson	2,913,355	11/17/59
Identifying labels	Waldemar E. Bihler	2,914,166	11/24/59
Pressure sensitive adhesive tape	Johnson & Johnson	2,914,167 2,914,416	11/24/59
Manufacture of adhesive plaster rolls	Manufacture de Bandes Platrees Adhesia	2,914,421	11/24/59 11/24/59
Refining starch hydrolysates	Elliott P. Barrett et al	2,914,431	11/24/59
Preparation of starch esters	Corn Products Co.	2,914,526	11/24/59

rod adhesives adapted for bonding metallic sheet material.

The rod is a heat softenable combination of reacted components including a polyamide resin and a polyepoxide resin together with a thermoplastic carrier. The composition includes a phenol which acts on the polyepoxide resin to reduce its freedom to react with the polyamide resin to form gelling polyamide epoxy reaction products at the relatively high temperature reached during application. At the same time the phenol provides additional hydroxyl groups which make the composition more polar and improves the wetting out and bonding of metallic surfaces.

Adhesive Lubricants

U. S. Patent 2,910,440, issued Oct. 27, 1959 to George R. Cook and Warren W. Cortiss, assigned to the Pure Oil Co., provides a fluid petroleum lubricant which is characterized by its adhesiveness to metal surfaces.

This invention is based on the discovery that a superior, readily reproducible, tacky but fluid, lubricant can be prepared by incorporating 1-15 per cent by weight of polymerized methyl esters of rosin in viscous residual oils obtained from the production of lubricating oils. The mixture is heated to 300° to 325° F. and thoroughly mixed in a grease-compounding kettle.

Cross-Linked Starch Product

U. S. Patent 2,910,467, issued Oct. 27, 1959 to Ernest L. Wimmer, and assigned to Chas. A. Krause Milling Co., provides a potential adhesive product of such a nature that when the pastes have been dried, the resultant material is less soluble in water and therefore more weather resistant than materials obtained using pastes prepared from starch or flour by conventional methods.

The starch is cross-linked by the use of the reagent hexahydro-1,3,5-triacryloyl-s-triazine, in the presence of an alkaline catalyst.

Method of Preparing Animal Glue

U. S. Patent 2,908,515, issued Oct. 13, 1959 to Harvard L. Keil, assigned to Armour & Co., describes a process for conditioning pork skins for gelatin or glue extraction, and for recovering the gelatin or glue

The pork skins are treated with a sterilizing agent. The sterilized skins are then subjected to the action of added living yeast-type organisms to condition the skins. The gelatin or glue is then extracted from the conditioned skins with water.

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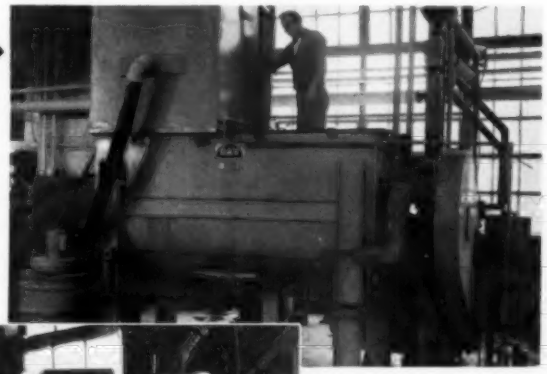

At a leading producer of printed products, this DAY Jumbo Mixer prepares starch-base pastes. Mixer is of stainless steel construction, jacketed, with live steam injection pipes. Has 25 hp. drive and total capacity of 700 gal.

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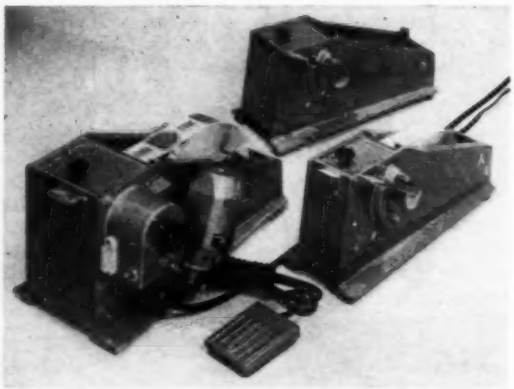
new equipment

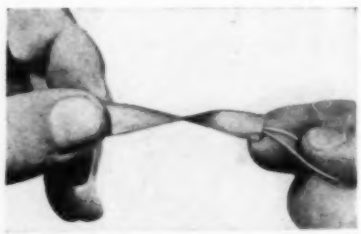
Label Dispensers

Three new Grip-A-Tab dispensers for pressure-sensitive roll labels feature a new method of feeding that increases the flow of labels and reduces costly time-consuming delays in production line labeling. In addition, a new feed and rewind mechanism results in considerably faster loading and easier operation and overcomes the problems created by adhesive transfer from labels to the liner paper. A two-part rewind core construction permits easy disposal of the rewound liner and eliminates the necessity of constant piecemeal tear-off of the liner. The machines may be equipped with an optional tear-off bar which permits the dispensing of varying length strips from roll stock not previously converted into labels. Known as the "L" series, Model LH-10 is designed for labels up to 1 inch wide (maximum web width 1¼ inches), and Model LH-20 is for labels up to 2 inches wide (maximum web width 2¼ inches). Both models are lever operated and are available with heaters at an extra cost. Model L-30 is for labels up to 3 inches wide (maximum web width 3¼ inches) and is electrically operated on either AC or DC current. This model is equipped with a heater and rheostat speed control that will deliver up to 15 feet of stock per minute depending upon the width and tackiness of the labels. *Derby Sealers, Inc.* **E-177**



Ribbon Temperature Sensor

Manufactured in tape-on or self-adhering models, Thermal-Ribbon is said to provide convenient and accurate sensing of temperature for monitoring or control in airborne, industrial and instrument applications. Measuring 3/16 by 2 by .020 inches, the ribbon is thin and flexible for use on flat, curved or irregular surfaces. The manufacturer reports that the sensor can also be built into equipment and used for temperature monitoring or control while the equipment is operating. Thermal-Ribbon is said to have a resistance of 676 ohms per degree C. at 25°C. and varies at a rate of 3.06 ohms per degree at 25°C. Depending on installation, thermal time constant is as small as ½ second. Each Thermal-Ribbon comes equipped with installation type and calibration curve for the operating range of −60° to +160°C. *Minco Products, Inc.* **E-178**



Two-Part Epoxy Mixer

Called Auto-Rex-Mixer, the unit is said to eliminate batch make-up and simplify the use of two-part epoxy compounds. An enclosed unit, it is designed for precision processing and accurate dispensing of corrosive and abrasive reactive resin mixes. The mixer will proportion, meter, mix and dispense multi-component resins. Short pot life resin mixes can be handled with ease and safety with a pot-life control which automatically replenishes the mixer with fresh component materials when the machine has not been cycled within the pot-life time. Simplified pushbutton operation automates the handling of epoxy resin mixes for adhesive applications, potting, embedment, encapsulation, impregnation and casting, and adjustable measured shots are dispensed on signal. According to the manufacturer, a unique and important built-in feature of the Auto-Rez-Mixer is a dispenser-valve which provides sharp cut-off of highly viscous or filled resins. Options such as deaeration, heating, agitation, dispensing under vacuum, and interlocking synchronization with automated production lines are available. The unit's dimensions are 24 inches deep by 36 inches wide by 60 inches high, and it weighs 550 pounds. *C.P.M. Special Machinery Corp.* **E-179**

Strip Roller Coater

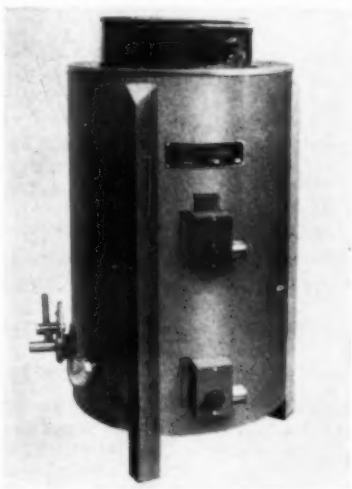
The Union Strip Coater permits adhesive application in given strips and patterns to many different types of materials, the manufacturer states. Strip rolls are adjustable for different patterns of adhesive and can be interchanged for wide or narrow glue strips as desired. Openings in the upper coating roll assemblies are adjustable to 2 inches through a gear-elevating mechanism with a single handwheel control. A variable speed drive is also available with any 3:1 ratio. The coating assembly of the strip coater consists of three rolls: a doctor roll, a transfer roll and a strip roll. The adhesive is carried in the crotch between the doctor and transfer rolls. Thick or thin coatings can be applied by a simple adjustment of the openings between these two rolls. Further control of the adhesive thickness can be obtained by running the strip rolls in and out toward the transfer rolls. The unit is available with rolls from 12 to 108 inches in length. *Union Tool Corp.* **E-180**

Wood Chip Impregnator

The Impressafiner is a new machine reported to be capable of greatly reducing the time needed for impregnating wood chips and other cellulosic materials. Designated the Bauer No. 567, the unit provides continuous pressurized impregnation with high uniformity. Where an hour or more was formerly required for the cooking or soaking of wood chips in certain processes in the pulp or board industries, impregnation can now be accomplished in a matter of seconds with the Impressafiner, the manufacturer claims. In addition to impregnating wood chips with cooking liquors, the unit can also be used for precise addition of bleaches and other chemicals, and for the restoration of moisture to sawdust, overly dried chips, hogged scrap lumber and similar materials. The screw press action of the unit also softens fiber bonds and thus separates fiber bundles without breaking or shortening the length of individual fibers. Daily capacity of the Impressafiner is rated at between 50 and 75 tons per day, depending upon operating conditions and the material being processed. *Bauer Bros. Co.* **E-181**

Adhesive Melter

A simplified hot-melt adhesive melter, Model AD24SS, performs two functions in one unit. The top



section of the melter is designed for freeing adhesive from 50 and 100 pound drums, and the lower section is for melting the material. The units are designed for close temperature control and ease of handling hot-melt adhesives. The temperature control consists of two thermostats with selective range of 150 to 450°F. The inside dimensions of the stainless steel liner are 16 inches by 28 inches deep, with flat bottom and lugs welded at proper location. The electric elements are arranged in two separate zones with low watt density. Accurate control over each zone of heat is provided by separate thermostats, and a thermometer is installed at a point so the stem is surrounded by the compound. A 2-inch stainless steel swing gate valve is suitably located to easily discharge the adhesive and is designed for especially viscous materials. *Sta-Warm Electric Co.* **E-182**

Carton Imprinter

The Cartoncoda is a new machine that imprints folding cartons in the flat at speeds to 350 per minute. Magazine-fed and foot-pedal controlled, the machine imprints code dates, lot or control numbers in any location on the carton surface. It handles almost any shape carton from ¾-inch by 2-inch to 8-inch by 12-inch. *Adolph Gottscho, Inc.* **E-183**

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book reviews

Adhesives Guide. ***By Joyce Hurd. Published by British Scientific Instrument Association, 'Sira', South Hill, Chislehurst, Kent, England. 6 x 9½ in. 140 pp. (Distributed in U.S. and Canada by Palmerton Publishing Co., Inc., 101 West 31st St., New York 1, N.Y., $3.50.)***

There are many excellent books on the science of adhesives and adhesion, as well as detailed studies of specific adhesive compounds, but the industry has very much needed an all-inclusive guide to various adhesive materials and their recommended fields of application. This handbook therefore fills a very real need to have the information available in a compact and easily assimilated form.

Though the emphasis of the book is on adhesives commercially available in Great Britain, the book as a whole will be of use to readers on both sides of the Atlantic. This would be true if it contained nothing more than its invaluable encyclopedia which outlines the properties and applications of basic adhesive types.

In a field that has expanded as rapidly as that of adhesives, keeping up with the proliferation of important materials available can become a problem which studies of this type go a long way towards simplifying. The more than 50 summaries offered here cover basic adhesive types from acrylics to waxes. If, for example, you've begun to be confused about just what constitutes a synthetic rubber-base adhesive, and when to use the various types, we recommend Mrs. Hurd's four-page discussion of the topic.

Asbestos: Its Industrial Applications. ***By D. V. Rosata. Published by Reinhold Publishing Corp., 430 Park Avenue, New York 16, N.Y. 5 x 7½ in. 214 pp. $5.75.***

This volume identifies the broad usage of asbestos in industry, and presents data on its properties and manufacturing methods. The author reviews the types of asbestos material available —asbestos cement, tile, asbestos heat and electrical insulation, asbestos friction materials, textiles, plastics, packings, gaskets, filters and others. A list of asbestos products is included. The volume serves as a convenient guide to various industrial branches including research and development groups, manufacturers, engineering schools, market research groups and sales management. All available data on asbestos has been accumulated in this one book. It answers the need for a complete review of this specialty material that is finding its way into an increasing number of new products and developments.

An Introduction to the Organic Chemistry of High Polymers. ***By Carl S. Marvel. Published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N.Y. 6 x 9 in. 82 pp. $4.50.***

This book is derived from the Humble Lectures in Science, presented by Prof. Marvel in June 1956. After first presenting a brief historical background of polymer chemistry, and a short discussion of the methods used to characterize polymers, the author embarks on a point-by-point study of polymer formation and reactions. The book first defines the terms to be used before going on to discussions of them. This procedure leaves no doubt in the reader's mind about exactly what is meant when reference is made to such basic concepts as: polymerization, linear polymers, condensation and addition polymerization, branched and cross-linked polymers, etc. The entire volume, from the method of presentation to the extent the subject is developed, is adapted to the interests of those just starting research in polymer chemistry.

Trade Literature

Directory of Plastic Packaging Suppliers. A 36-page directory that lists both custom and proprietary plastics packaging molders and extruders in the United States, in alphabetical order. The directory, called Directory C-10-211, lists under each company name information that includes a description of the type of service the company is equipped to provide and the name of the officers of each company. *Koppers Co., Inc.* **L-202**

Weldwood Adhesives. A loose-leaf type brochure that presents technical data on the properties, uses and applications of the company's line of Weldwood adhesives. The brochure is divided into five sections which include data sheets on Weldwood Plastic Resin Glue; Contact Cement; Presto-Set Glue; Waterproof Resorcinol Glue; and Super Contact Cement. *U.S. Plywood Corp.* **L-203**

Bonding Elastomers to Synthetic Fabrics. Bulletin BL-361 is titled "Aqueous Adhesive for Bonding Elastomers to Synthetic Fabrics." This four-page bulletin contains data on bonding synthetic fibers to elastomers by adhesives containing isocyanate. Described are compounding; effect of curing conditions and concentration of Hylene MP; types of neoprene latex; application of adhesive to fabric; stability of adhesive compounds and treated fabrics, and effect of liberated phenol. The bulletin explains that this type of adhesive system is suitable for the treatment of fabrics made from nylon or Dacron polyester fiber for use in belting and coated fabrics. *E. I. du Pont de Nemours & Co.* **L-204**

Release and Separating Papers. A new technical data bulletin on release and separating papers is available in the form of an attractive file folder which describes various types of release and separating papers as well as the coatings required for a wide variety of applications. The bulletin reveals that such papers are used with polyvinyl ether masses, synthetic rubber and natural rubber adhesives, as well as for film castings, container liners and for interleaving caulking compounds and other tacky materials. *Riegel Paper Corp.* **L-205**

Adhesives Applying Devices. The Thermogrip line of adhesives applying devices is described in this 16-page brochure. The booklet covers hot melt adhesive in coils; wheel type applicators Models CW, AW and BW; and nozzle type applicators Models BN, AN and CN. Application data describes installation, electric power, applicator drive, materials handling, pressure, air, open time, transfer wheels, nozzles and field service. Also discussed are uses of nine types of Thermogrip adhesives. *United Shoe Machinery Corp.* **L-206**

New Epoxy Resins. Three new epoxy resins, said to display novel structures, reactivity and curing characteristics, are described in this 24-page booklet. The booklet, called Data for Industry, No. 1, deals with the physical properties of the firm's Oxiron series, 2000, 2001 and 2002, and tells how these resins differ from conventional epoxies of commerce. The data booklet provides the necessary technical information for correct economic handling of these new resin materials. *Food Machinery & Chemical Corp.* **L-207**

Bostik Applicator-Model B. An adhesive applicator that feeds solvent and water-based adhesives through a flexible hose directly into a brush under ordinary factory air pressure is the subject of this two-page bulletin. In addition to a full description of the applicator, its basic part, and a listing of its advan-

TECHNOLOGY OF ADHESIVES AT YOUR FINGERTIPS

SERVICE

Subscribers to ADHESIVES AGE may now obtain, from one central source, technical literature dealing with all aspects of the adhesives industry. One or more of the books listed here may be of invaluable assistance to you. Look this list over and check the books suited to your needs.

- **Adhesive Bonding of Metals—G. Epstein. $2.95.** Considers adhesives used with metals, indicating when an adhesive-bonded joint is advantageous; the type adhesive to use; how to use it, and how to design the joint for optimum performance. ☐

- **Adhesive Bonding of Reinforced Plastics—H. A. Perry. $8.75.** Survey of the design and assembly of structures and products, particularly glass-fiber-reinforced plastic products, by means of adhesives. Gives data on equipment and methods used to produce adhesive bonded joints. ☐

- **Adhesion and Adhesives—N. A. De Bruyne and R. Houwink. $13.50.** A collection of information on the scientific and technological aspects of adhesion. Part I deals with theory, while Part II is devoted to the technology of adhesion. ☐

- **Epoxy Resins—Their Applications and Technology—H. Lee and K. Neville. $8.00.** Guide to the field of epoxy resins, covering the chemistry of their preparation and applications, including a section on adhesives. ☐

- **Polyamide Resins—Donald E. Floyd. $4.50.** Discusses in detail various important applications of the polymers belonging to the polyamide resin family and includes a comprehensive section on adhesives. ☐

- **Principles of High Polymer Theory and Practice —A. X. Schmidt and C. A. Marlies. $13.50.** Study of the principles of high-polymer theory and practice, with a section on adhesives, their applications, and mechanisms and factors involved. ☐

- **Recent Advances in Gelatine and Glue Research —G. Stainsby (Editor). $12.00.** Study of Collagen, and its protein gelatine, comprising papers and Proceedings of an International Conference of the British Gelatine and Glue Research Association. ☐

- **Vinyl Resins—Mayo Smith. $5.75.** Surveys applications of vinyl resins with information on their types, properties, chemistry, manufacture and fabrication. Includes information on several types of adhesives in this category. ☐

- **Epoxy Resins—Irving Skeist. $5.50.** A chapter on adhesives is included in this complete study of the entire field of epoxy resins. The author gives formulations, trade names, methods of manufacture and applications. ☐

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tages over hand brush application of adhesives, the literature illustrates the full line of interchangeable brush tips available and gives complete price and shipping weight information. *B. B. Chemical Co.* **L-208**

Ketones. A new 48-page booklet describing ketones as solvents and chemical intermediates is now available. The booklet has up-dated data on 15 ketones and diketones that are available in commercial quantities from the manufacturer. It includes information on applications, coatings, formulations, physical properties, solvent properties, constant-boiling mixtures, shipping, storage, handling, physiological properties, specification limits, and test methods. A comprehensive bibliography on ketones and their uses is a feature of the publication. *Union Carbide Chemicals Co.* **L-209**

Masking Spray Coater. This brochure describes a method of application of coating compounds to small articles, such as electrical and electronic components at a rate of 4,000 per hour. The bulletin explains how sprayable resinous compositions, such as epoxy compounds, can be used to completely form a light tight seal for selenium diodes, through the use of Model HD-2 remote masking spray coater. *Conforming Matrix Corp.* **L-210**

Coatings for Vacuum Metallizing. A 45-page comprehensive booklet that describes in detail the application and use of vacuum metallizing coatings which may be applied by spraying, dipping, and flow coatings to thermoplastics, thermosetting plastics, metals and glass. Base coats for use before metallizing as well as top coats and back-up coats for use after metallizing are discussed along with other helpful information on the metallizing operation. *Bee Chemical Co.* **L-211**

Adhesives, Laminating Materials and Putties. This condensed six-page catalog describes the company's complete line of adhesives, laminating materials, putties and sandwich core. The data is presented in easy-to-read chart form. The catalog also contains a temperature chart that indicates the upper and lower service limits for each adhesive and laminating material in the line. *Narmco Resins & Coatings Co.* **L-212**

Gerin Electric Heaters. A technical bulletin that describes features of new Gerin electric heaters designed for the transfer of heat by circulating thermal liquids. Designated Bulletin No. 108, it contains a complete description of the advantages of the electric heat transfer systems, and contains a phantom illustration of a typical packge unit. Also illustrated is a unit flow schematic. *Gerin Manufacturing Co., Inc.* **L-213**

Tablet Coatings and Granulating Agents. This technical bulletin is a comprehensive study on the use of Gelva C-3, polyvinyl acetate, resins and Gelvatol, polyvinyl alcohol, resins as tablet coatings and granulating agents. The bulletin contains separate sections covering the use of the resins in film and enteric coatings, antioxidant coatings, and tablet binders. Also included is information on compounding in solvent and water systems. *Shawinigan Resins Corp.* **L-214**

Impressafiner. Bulletin No. 32 describes No. 567 Impressafiner which is used for continuous pressurized impregnation of wood chips and other cellulosic materials. Cut-away photo diagrams illustrate how the Impressafiner first compresses material, exhausts the air and moisture from it, and then expands the material in the impregnations chamber, in the presence of the liquid processing chemicals. *Bauer Bros. Co.* **L-215**

Envelope Adhesive. A 12-page booklet about Flash Seal, a new type of envelope front seal adhesive. Described are the origin and development of Flash Seal; the difference between Flash Seal and conventional front seal adhesives; operation; manufacturing advantages; storage advantages; and how to set up and run Flash Seal. *Stein, Hall & Co., Inc.* **L-216**

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in passing

Subliminal Shenanigans

With apologies to the Goodyear-Australian *Wingfoot Clan* and the *General Electric News* we offer, as a public service, the following explanation of a new advertising technique:

You've heard of subliminal advertising . . .

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where a sponsor flashes his message across your

subscribe to adhesives age

television screen so quickly that you don't even

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know it's there. Even though everything happens

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so quickly that you don't realize you have been

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exposed to the message, you feel the urge to go

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to your refrigerator and get some of the sponsor's

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product. This, for example, is a subliminal article.

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Read it carefully. Feel any new urge to get out

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and do something?

subscribe to adhesives age

Watch It There

The U. S. Internal Revenue Service estimates a $5 billion annual gap between interest and dividends paid to individuals and the amount reported on Federal income tax returns. Says Dana Latham, U. S. Commissioner of Internal Revenue, "We believe that this gap is due primarily to a misunderstanding of the law and inadequate investor records which inevitably result in omission of small amounts (small for the individual taxpayer but large when added up for all taxpayers)." Better check the new 1959 Federal income tax return and instructions which spell out the reporting requirements for dividends and interest. Then, if you find you should report such income, you will have time to get your records together before that April 15 deadline catches up with you.

Farmer's Food Dollar

Farmers received 38 cents of each dollar consumers spent for farm foods in retail stores in 1959—2 cents fewer than they did in 1958. In recent months it has dropped to 37 cents. In 1959 the farmer's share was reduced by the decline in farm prices and a slight increase in marketing charges. Prices received by farmers for foods were 7 per cent lower in 1959 than in 1958. Marketing charges rose 1 per cent from 1958 to 1959—one of the smallest increases since 1947.

Retail prices of farm foods decreased in 1959 for the first time since 1955. They probably will not change much in 1960 as increases in marketing charges will partly offset lower farm values. The farmer's share rose from 38 cents in 1939 to 53 cents in 1945. Then it declined to 47 cents in 1949 and 1950. In 1951, during the Korean conflict, it rose to 49 cents. It remained at 40 cents from 1956 through 1958 before dropping to 38 cents in 1959.

Going Up

Magazine Publishers Association made a recent survey that forecasts a surge in advertising volume in 1960. The report indicates that a record $885,000,000 will be spent this year, an increase of 12 per cent over 1959. A gross circulation increase to $402,000,000, about 5 per cent over 1959, is also expected. J. K. Lasser & Co., public accountants, conducted the survey. Seventy publishers, accounting for 90 per cent of consumer and farm magazines and a number of business papers, participated in the forecast.

Radium Dials

Luminous dials are usually mentioned when the subject of background exposure to radiation comes up. The average luminous dial watch, worn continuously, gives a 20 mr per year dose to the gonads. Though this is not a large amount, it should be considered in evaluating exposure.

Weatherspeak

The U. S. Weather Bureau has developed an improved grasp of semantics. Instead of predicting that next day's weather will be "partly cloudy," the bureau's copywriters now assure you that it will be "partly sunny."

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